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U.S. Bureau of mines

MINERALS YEARBOOK

1946

Prepared under the direction of

E. W. PEHRSON

Chief, Economics and Statistics Division

ALLAN F. MATTHEWS, *Editor*

UNITED STATES DEPARTMENT OF THE INTERIOR

J. A. KRUG, *Secretary*

BUREAU OF MINES

JAMES BOYD, *Director*

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FOREWORD

This annual publication of the Bureau of Mines is more than a mere compilation of economic and statistical information. It is a measure of the basic strength of the Nation's industrial structure, for the ebb and flow of mineral commodities through a country's economic arteries are reliable indications of its industrial vigor and progress.

The year 1946, the first postwar year, was a time of transition—a period of reconversion—when the inordinate requirements of war gave way to the pent-up demands of domestic consumers. This changeover from a wartime to a peacetime economy is reflected in the statistics presented in each of the individual commodity chapters.

The Minerals Yearbook for 1946 chronicles in detail this first year of transition and provides information which is of value to America's businessmen, labor leaders, educators, Government executives and legislators, and others who share in charting our national course.

The Bureau of Mines deeply appreciates the assistance of the minerals industry in providing information for this volume and also wishes to acknowledge the help of the many State geologists who cooperated in compiling production data.

JAMES BOYD, *Director.*

CONTENTS

	PAGE
Foreword, by James Boyd	III
Introduction, by Allan F. Matthews	VII
Part I. General Reviews:	
Review of the Mineral Industries in 1946, by Allan F. Matthews and E. W. Pehrson	1
Statistical Summary of Mineral Production, by John Hozik	13
Employment and Injuries in the Mineral Industries, by Forrest T. Moyer	74
Part II. Commodity Reviews:	
Abrasive Materials, by Robert W. Metcalf and A. B. Holleman	92
Aluminum, by C. E. Nighman and Mary E. Trought	111
Antimony, by Richard H. Mote	128
Arsenic, by Richard H. Mote	137
Asbestos, by G. W. Josephson and Dorothy I. Marsh	143
Asphalt and Related Bitumens, by A. H. Redfield	152
Barite, by Charles L. Harness and F. M. Barsigian	161
Bauxite, by Hubert W. Davis and Mary E. Trought	174
Bismuth, by Richard H. Mote	187
Cadmium, by Richard H. Mote	191
Carbon Black, by F. S. Lott and H. Backus	197
Cement, by G. Richards Gwinn and Esther V. Balser	207
Chromium, by Edwin K. Jenckes	237
Clays, by G. W. Josephson and A. Linn	247
Coal—Bituminous and Lignite, by W. H. Young, R. L. Anderson, and L. H. Isaac	264
Coal—Pennsylvania Anthracite, by J. A. Corgan and Marian I. Cooke	349
Cobalt, by Hubert W. Davis	391
Coke and Coal Chemicals, by J. A. De Carlo, J. A. Corgan, and Maxine M. Otero	400
Copper, by Charles White Merrill and Helena M. Meyer	457
Feldspar, by Robert W. Metcalf and A. B. Holleman	490
Ferro-Alloys, by Norwood B. Melcher	501
Fluorspar and Cryolite, by Hubert W. Davis and Gertrude N. Greenspoon	507
Fuel Briquets and Packaged Fuel, by Gertrude S. Goodman	525
Gem Stones, by Sydney H. Ball	544
Gold and Silver, by Charles White Merrill and Helena M. Meyer	557
Gypsum, by Charles L. Harness and M. G. Downey	588
Iron Ore, by Norwood B. Melcher	600
Iron and Steel, by Norwood B. Melcher	626
Iron and Steel Scrap, by Norwood B. Melcher and James E. Larkin	642
Lead, by Richard H. Mote	665
Lead and Zinc Pigments and Zinc Salts, by Helena M. Meyer and Alethea W. Mitchell	690
Lime, by Charles L. Harness and F. D. Gradijan	708
Magnesium, by C. E. Nighman and Mary E. Trought	724
Magnesium Compounds and Miscellaneous Salines, by Charles L. Harness and F. M. Barsigian	736
Manganese, by Norwood B. Melcher	751
Mercury, by Helena M. Meyer and Alethea W. Mitchell	767
Mica, by G. Richards Gwinn and E. M. Tucker	783
Molybdenum, by Edwin K. Jenckes	797
Natural Gas, by F. S. Lott and H. Backus	805
Natural Gasoline and Liquefied Petroleum Gases, by F. S. Lott and A. T. Coumbe	835
Nickel, by Hubert W. Davis	856
Nitrogen Compounds, by Bertrand L. Johnson	862
Peat, by J. A. Corgan and Golden V. Chiriaco	866

	PAGE
Part II. Commodity Reviews—Continued	
Petroleum and Petroleum Products, by A. G. White, F. S. Lott, A. T. Coumbe, J. C. Casper, and A. L. Clapp	870
Phosphate Rock, by Bertrand L. Johnson and E. M. Tucker	988
Platinum and Allied Metals, by Hubert W. Davis and Gertrude N. Greenspoon	1006
Potash, by Bertrand L. Johnson and Dorothy I. Marsh	1017
Salt, by Florence E. Harris and E. M. Tucker	1031
Sand and Gravel, by G. Richards Gwinn and G. E. Tucker	1046
Secondary Metals—Nonferrous, by Herbert L. Cullen and A. J. McDermid	1065
Slate, by Robert W. Metcalf and M. G. Downey	1094
Stone, by G. W. Josephson and Nan C. Jensen	1102
Sulfur and Pyrites, by G. W. Josephson and M. G. Downey	1135
Talc and Pyrophyllite, by Bertrand L. Johnson and F. M. Barsigian	1150
Tin, by C. E. Nighman and J. B. Umhau	1159
Titanium, by Helena M. Meyer and R. Louise Bryson	1183
Tungsten, by Hubert W. Davis	1192
Uranium and Thorium, by Allan F. Matthews	1205
Vanadium, by Edwin K. Jenckes	1232
Zinc, by Richard H. Mote and Esther B. Miller	1240
Minor Metals, by Allan F. Matthews	1266
Minor Nonmetals, by G. Richards Gwinn	1285
Part III. State Reviews:	
The Mineral Industry of Alaska, by Alfred L. Ransome	1299
Gold, Silver, Copper, Lead, and Zinc in—	
Arizona, by C. E. Needham and Paul Luff	1311
California, by Alfred L. Ransome	1336
Central States, by A. J. Martin	1367
Colorado, by S. A. Gustavson	1387
Eastern States, by A. J. Martin	1413
Idaho, by C. E. Needham and Paul Luff	1424
Montana, by C. E. Needham and Paul Luff	1450
Nevada, by Alfred L. Ransome	1473
New Mexico, by S. A. Gustavson	1495
Oregon, by Alfred L. Ransome	1509
South Dakota, by S. A. Gustavson	1520
Texas, by S. A. Gustavson	1525
Utah, by C. E. Needham and Paul Luff	1530
Washington, by C. E. Needham and Paul Luff	1549
Wyoming, by S. A. Gustavson	1559
Part IV. Foreign Mineral Reviews:	
The Mineral Industry of Middle and South America, by Sumner M. Anderson	1561
Index, by Mabel E. Winslow	1605

INTRODUCTION

Compilation of Minerals Yearbook, 1946, was carried on in conformity with standards adopted for preceding issues in the series. A few changes in make-up will be noted, particularly the alphabetization of chapters, the substitution of more readable Sans Serif type for Century type in principal headings, and the use of bolder type in side headings and table headings. Publication of the bound volume was delayed by arbitrary reductions in staff and by an increased number of special assignments, particularly in regard to Marshall Plan and Munitions Board studies.

The entire volume was assiduously reviewed for statistical accuracy and consistency by John Hozik, statistical editor, who in addition authored the keystone chapter—Statistical Summary of Mineral Production. Mabel E. Winslow, of the Office of Minerals Reports, with the assistance of Anna B. Brown, edited the entire manuscript (particularly for grammar and style), applied type specifications, and prepared the exhaustive index. Louis F. Perry, of the Office of Minerals Reports, and Adelaide B. Palmer, of the Economics and Statistics Division, were responsible for preparation of the charts. K. Joyce D'Amico rendered considerable assistance to the statistical editor in reviewing manuscripts and preparing statistical tables.

Development and execution of the publishing program were greatly facilitated by the friendly and competent advice of H. D. Keiser, former editor of Minerals Yearbook, and by John H. Ady, Chief of Publications of the Interior Department and liaison officer between the Department and the United States Government Printing Office. Review of the Uranium and Thorium chapter by J. H. Rush, secretary, Federation of American (Atomic) Scientists, is much appreciated.

Minerals Yearbook can be published only as a result of the detailed information supplied by mining companies, trade associations, business magazines, scientific journals, Government agencies, and countless individuals. Notable is the cooperation received from the United States Department of Commerce, which provided data on foreign trade; the United States Department of State, which supplied information on foreign production; and the various States that have executed cooperative agreements with the Bureau. Under these agreements, producers and consumers of minerals complete but one set of inquiries, and the State officials are given the detailed information supplied to the Bureau of Mines by respondents in their respective States. State agents cooperating in the 1946 canvass were:

Alabama: Walter B. Jones, State geologist, University.
Florida: Herman Gunter, director, Florida Geological Survey, Tallahassee.
Georgia: Garland Peyton, director, Division of Mines, Mining and Geology, Atlanta.
Illinois: M. M. Leighton, chief, and Douglas F. Stevens, research associate, State Geological Survey Division, Urbana.
Iowa: A. C. Trowbridge, director, Iowa Geological Survey, Iowa City.
Kansas: Raymond C. Moore, director, and John C. Frye, assistant director, State Geological Survey of Kansas, Lawrence.

Maryland: Joseph T. Singewald, Jr., director, Department of Geology, Mines and Water Resources, Baltimore.
Michigan: Gerald Eddy, State geologist, Geological Survey Division, Lansing.
Missouri: Edward L. Clark, State geologist, Rolla.
New Hampshire: T. R. Myers, geologist for State Planning and Development Commission, Durham.
New Jersey: Meredith E. Johnson, State geologist, Trenton.
New York: John G. Broughton, acting State geologist, Albany.
North Carolina: Jasper L. Stuckey, State geologist, Raleigh.
Oklahoma: Robert H. Dott, director, Oklahoma Geological Survey, Norman.
South Dakota: E. P. Rothrock, State geologist, Vermillion.
Texas: John T. Lonsdale, director, Bureau of Economic Geology, Austin.
Utah: Aaron W. Tracy, chairman, State Department of Publicity and Industrial Development, Salt Lake City.
Virginia: William M. McGill, State geologist, and Linwood H. Warwick, junior executive, Virginia Geological Survey, Charlottesville.
Washington: Sheldon L. Glover, supervisor, Division of Mines and Mining, Olympia.
West Virginia: Paul Price, State geologist, Morgantown.
Wisconsin: E. F. Bean, State geologist, Madison.

In addition, B. D. Stewart, Department of Mines, Juneau, Alaska, and Walter W. Bradley, State mineralogist, San Francisco, Calif., assisted in the compilation of statistics for Alaska and California, respectively.

It is desirable to acknowledge the work of the statistical analysts and others in the Economics and Statistics Division who were of major assistance to authors in compiling the statistics appearing in various chapters. Those engaged on such work in the Washington, D. C., offices of the division were Charlotte R. Buck, Leon W. Geyer, Annie L. Marks, Robert C. Morris, Virginia M. Oliver, Carribel Rockwell, and Virginia E. Wrenn; in the Los Angeles, Calif., office, Edward T. Knudsen; in the San Francisco, Calif., office, Opal Y. Sharman; in the Denver, Colo., office, Helen G. Post, Florence H. Scott, and Tressa B. Westall; in the College Park, Md., office, Edith E. den Hartog and Helen P. Mackall; and in the Salt Lake City, Utah, office, Alice Feltch, Virginia Halverson, LaRu T. Shepherd, and Edna P. Wolfgramm.

ALLAN F. MATTHEWS

PART I. GENERAL REVIEWS

Review of the Mineral Industries in 1946[1]

By ALLAN F. MATTHEWS AND E. W. PEHRSON

	PAGE
Production	2
Value of production	2
Volume of production	3
Consumption	4
Stocks	5
Prices	5
Employment and safety	6
Government strategic stock pile	6
List of strategic minerals	7
Government organization for reconversion	8
Office of Temporary Controls	8
Civilian Production Administration	8
Office of Price Administration	9
Government organization for reconversion—Continued	
War Assets Administration	9
Atomic Energy Commission	9
U. S. Department of the Interior	10
Solid Fuels Administration for War	10
Coal Mines Administration	10
Petroleum Administration for War	11
Oil and Gas Division	11
Reconstruction Finance Corporation	11

MINERAL production in the United States attained a record value of $8,859,000,000 in 1946. The volume of production was third only to that in 1944 and 1945 and was kept from an all-time high by work stoppages in key industries during the spring. Consumption of petroleum, fertilizers, and building materials was at high levels, but usage of the metals in 1946 declined as compared with 1945. The average increase in prices of minerals during 1946 was 10 percent, which was less than for most other commodities. The availability of manpower in the mineral industries in 1946 equaled demand for the first time in several years. The safety record receded during the year, but the fatality rate was the lowest on record.

The Congress enacted two significant laws that have important effects on the mineral industry: Strategic and Critical Materials Stock-Piling Act (July 23, 1946) and the Atomic Energy Act of 1946 (August 1). Government allocation controls were maintained during 1946 on only four mineral products—steel, tin, antimony, and uranium. Government price controls on minerals were relaxed progressively during the first 10 months of the year and were removed entirely November 10, 1946.

[1] In this volume the term "billion" is equivalent to 1,000,000,000.

PRODUCTION

Value of Production.—Mineral output in the United States in 1946 reached a record value of $8,859,000,000, an increase of 9 percent over 1945 and 5 percent over the previous peak of 1944. The record comprised a 10-percent increase in value of mineral fuels in 1946 compared with 1945 and an 8-percent decline in metals that was more than offset by a 37-percent increase in nonmetallic minerals (other than fuels). Of the three major groups in 1946, fuels were valued at $5,725,000,000 (65 percent of the total), other nonmetallics $1,311,000,000 (15 percent), and metals, $1,823,000,000 (20 percent).

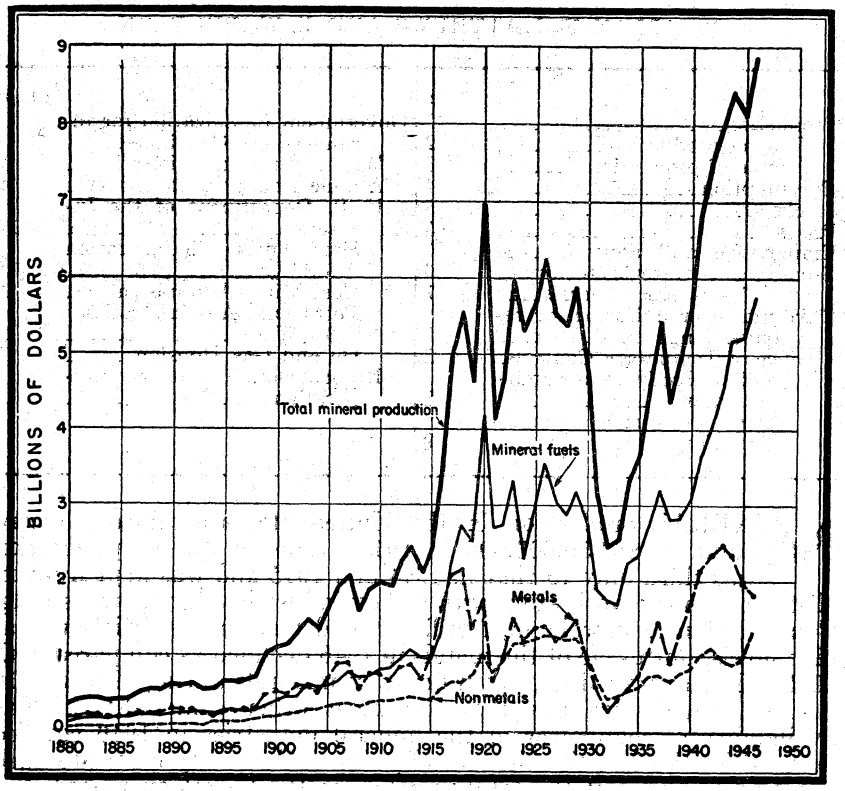

FIGURE 1.—Trends in value of mineral production in the United States, 1880–1946.

The 9-percent increase in value of mineral output in 1946 compares with a 14-percent increase in gross farm income, a 4-percent decrease in gross national product, and a 3-percent decrease in national income. This comparison is based on Bureau of Agricultural Economics reports on gross farm income ($25,432,000,000 in 1945 and $28,933,000,000 in 1946) and on Bureau of Foreign and Domestic Commerce reports on gross national product ($213,120,000,000 in 1945 and $203,679,000,000 in 1946) and national income ($182,808,000,000 in 1945 and $178,204,000,000 in 1946). Of the 178-billion-dollar national income in 1946, 3.1 billion (as computed by the Bureau of

Foreign and Domestic Commerce) was contributed by the mining industry, 5.9 billion by iron and steel, and 4.7 billion—in three approximately equal shares—by nonferrous metals, products of petroleum and coal, and stone, clay, and glass products.

Volume of Production.—Declines in the physical volume of production in 1946 compared with 1945 were 2 percent for minerals, 1 percent for agricultural products, and 16 percent for industrial products (manufactures and minerals), according to the Federal Reserve Board. The Board's index of mineral production (1935–39=100) was 134 in 1946—exceeded only by 137 in 1945 and 140 in 1944. The annual average for 1946 was held to 134 principally as a result of the concurrence of coal, iron-ore, and nonferrous-smelter strikes in April and May, causing the monthly index to drop to 104 and 115, respectively. The average of the other 10 months of the year was 141—a higher level than any yearly average to date. Furthermore, a record monthly high of 146 was reached in July and September 1946, surpassing the previous peak of 143 in May and September–November 1944.

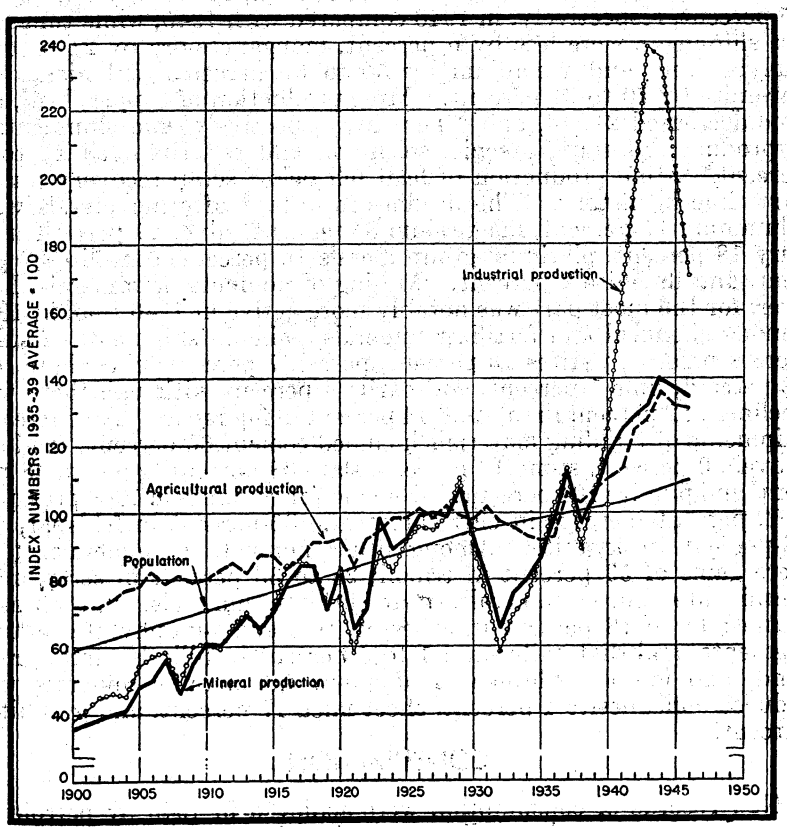

FIGURE 2.—Comparison of growth of physical volume of mineral production with that of agricultural and industrial production and population, 1900–46.[2]

[2] The following indexes have been used: Volume of farm production, U. S. Department of Agriculture; mineral production, 1900–1918, Warren Persons' Forecasting Business Cycles; mineral production of 1919–46 and industrial production, Federal Reserve Board; total population of the United States, Bureau of the Census.

Notwithstanding a decline in total production of minerals, new output records were established in 1946 by a number of nonmetallic minerals. Of the fuels, new peaks were recorded for petroleum, natural gas, natural gasoline, and fuel briquets. The chemical and fertilizer minerals sulfur, potash, and phosphate rock and the ceramics minerals clay, feldspar, aplite, olivine, and zircon also reached new highs in 1946, as also did carbon black, slate, talc and pyrophyllite, barite, rutile, and peat.

The volume of bituminous coal produced in 1946 declined 8 percent from that of 1945 as a result of strikes, but the output of anthracite increased 10 percent, crude petroleum 1 percent, natural gas 4 percent, and natural gasoline and related products 3 percent. Production of all ores and metals declined in 1946, except for increases in zinc-lead ore of 3 percent, dry and siliceous gold and silver ore 51 percent, gold 57 percent, beryl 156 percent, and rutile 3 percent. Even these gains (except for rutile) were largely restitutions of decreases in 1945 from 1944. Iron ore, pig iron, and ferro-alloys output declined 20, 16, and 15 percent, respectively, in 1946 compared with 1945, while tungsten-ore shipments were less by 6 percent, manganese-ore by 21 percent, molybdenum and vanadium by 50 to 57 percent, and nickel and chromite by 70 to 71 percent. Mine production of copper, lead, and zinc decreased 21, 14, and 6 percent, respectively, and shipments of byproduct cadmium, arsenic, selenium, and tellurium fell 23 to 50 percent. Mine production of lead fell below scrap recovery for the first time in history. The declines in output of other metals were: Aluminum 17 percent, magnesium 84 percent, silver 27 percent, mercury 18 percent, platinum-group metals 10 percent, tantalite 37 percent, and ilmenite 8 percent. Mining of nonmetallic minerals, however, for the most part was notably more active in 1946 than in 1945. Among chemical and fertilizer minerals, gains in shipments of sulfur were 8 percent, pyrites 13 percent, potash 7 percent, phosphate rock 18 percent, lime 1 percent, and barite 4 percent, although there were declines of 2 percent in salt and 14 percent in fluorspar. The increased shipments of building materials included cement 60 percent, sand and gravel 30 percent, stone 17 percent, slate 38 percent, gypsum 48 percent, and pumice 104 percent. Demand for ceramics in 1946 prompted a 62-percent increase in clay shipments, 36-percent in feldspar, and 38-percent in kyanite. Among other nonmetallic minerals, there were gains of 59 percent in tripoli; 23 to 33 percent in scrap mica, vermiculite, boron minerals, peat, lithium minerals, and abrasive garnet; 14 to 18 percent in asbestos, talc and pyrophyllite, natural pigments, and diatomite; and 1 to 4 percent in fuller's earth, greensand, and iodine. Shipments of a few nonmetallic minerals were reduced—magnesite 4 percent, sheet mica 17 percent, and graphite 9 percent.

CONSUMPTION

New records of consumption were achieved in 1946 by petroleum, natural gas, natural gasoline, potash, phosphate rock, titanium, barite, and carbon black. Consumption of bituminous coal declined 11 percent in 1946 compared with 1945, but that of anthracite increased 4 percent, crude petroleum 1 percent, natural gas 5 percent, and natural gasoline (including liquefied petroleum gases) 3 percent.

Industrial consumption of gold gained 41 percent and of titanium 5 percent, but usage of other principal new metals declined—pig iron 15 percent, copper 2 percent, lead 17 percent, zinc 6 percent, aluminum 42 percent, magnesium 78 percent, silver 31 percent, and molybdenum 54 percent. Consumption of cement and clay in 1946 increased about 60 percent, sand and gravel 30 percent, stone 17 percent, phosphate rock 15 percent, potash 7 percent, and lime 1 percent. Indicated consumption of sulfur and salt, on the other hand, dipped 2 percent.

STOCKS

Producers increased their stocks of anthracite 93 percent, phosphate rock 43 percent, and potash, lead, and molybdenum 11 to 15 percent during 1946, whereas they decreased stocks of aluminum 64 percent, copper 26 percent, zinc 31 percent, cement 33 percent, and sulfur 6 percent. Producers and consumers of pig iron depleted their inventories 26 percent. Consumers of bituminous coal, copper, and zinc built up their stocks 3, 9, and 28 percent, respectively, but lead consumers used up 59 percent of their stocks during 1946. Government holdings of strategic minerals by the Office of Metals Reserve were largely liquidated—partly by sales to industry and partly by transfers to the Bureau of Federal Supply in accordance with the Strategic and Critical Materials Stock-Piling Act.

PRICES

Mineral prices advanced 10 percent in 1946, according to the Bureau of Mines index of producers' realizations on 24 minerals that represented about 96 percent of the total value of United States mineral production. As a group, fuels showed the greatest price increase—12 percent; metals were up 9 percent, and nonmetallics (other than fuels) 6 percent. Of the 24 major minerals, average prices were lower in 1946 than in 1945 for natural gasoline, ferro-alloys, and clays, and they were essentially unchanged for sulfur (domestic sales), aluminum, magnesium, gold, and molybdenum. The most pronounced increases in average prices were 27 percent for lead, 20 percent for copper, about 15 percent for petroleum, anthracite, and silver, and some 10 percent for bituminous coal, pig iron, lime, and phosphate rock. The average value of anthracite at mines in 1946 was the highest on record, as also was the New York price of lead at the end of the year. The price of copper rose above that of aluminum for the first time in history

Weighted average price index of 24 major mineral commodities, 1941–46

[1940=100]

	1941	1942	1943	1944 [1]	1945 [1]	1946 [2]
Minerals (all groups)	109.4	114.7	119.7	122.7	125.3	138.0
Metals [3]	109.2	114.2	117.1	118.0	120.9	132.0
Mineral fuels	110.7	116.2	122.6	126.9	129.5	144.4
Nonmetals (other than fuels)	103.1	108.8	112.0	113.7	115.4	122.2

[1] Revised figures.
[2] Subject to revision.
[3] Includes bonus payments on copper, lead, and zinc after 1941.

in November 1946, and by the end of the year stood about 30 percent higher. Even the price of secondary aluminum exceeded (in December) the price of virgin aluminum!

The Bureau of Labor Statistics index (1926=100) of wholesale prices for all commodities rose 14 percent from 105.8 in 1945 to 121.1 in 1946, and for farm products alone 16 percent from 128.2 to 148.9. The indexes for various minerals and mineral products in 1945 and 1946, respectively, were as follows: Bituminous coal, 123 and 133; coke, 133 and 140; anthracite, 99 and 109; petroleum and products, 64 and 68; gas, 78 and 81; iron and steel, 99 and 110; structural steel, 107 and 118; nonferrous metals, 86 and 100; fertilizer materials, 82 and 87; cement, 99 and 104; brick and tile, 112 and 123; paint and paint materials, 107 and 119.

The inflationary trend of increasing prices in 1946 was checked to some extent by Government price control during the first 10 months of the year. However, price control on all commodities (except sugar and rice) was terminated effective November 10, 1946, by retroactive order of Paul A. Porter, Price Administrator, dated November 12.

EMPLOYMENT AND SAFETY

Supply of manpower in the mineral industries in 1946 equaled the demand for the first time since 1942. Average employment increased from 636,475 in 1945 to about 674,700 in 1946 (exclusive of workers in the petroleum and natural-gas industries). Of the 1946 total shown, 68 percent represents men in coal mines, 13 percent in quarries and other nonmetal mines, 10 percent in metal mines, 6 percent in metallurgical plants, and 3 percent in coke plants.

Despite the 6-percent increase in average number of men working in 1946 compared with 1945, there was a 7-percent decrease in man-hours worked, reflecting work stoppages—principally at coal and metal mines and coke and metallurgical plants. The average number of days worked by the mineral industries was 273 in 1945 and 244 in 1946. The only departure from the general trend among major groups was by quarries, which were worked 264 days in 1945 and 270 in 1946. The average length of shift in the extractive industries was 8.42 hours in 1945 and 8.29 hours in 1946.

The safety record of the mineral industries receded in 1946, and the frequency of injuries increased from 52.6 per million man-hours of work in 1945 to 55.4 in 1946. Fatality experience was improved, however; both the total of 1,161 fatalities and rate of 0.85 per million man-hours in 1946 were the lowest on record. The number of nonfatal injuries—74,425—was lower; but, owing to the reduced worktime, these injuries occurred at a somewhat higher rate. A principal factor in the retrogression of mine safety during 1946 was incomplete training in safe job methods for the experienced men shifted into new occupations and for the new and inexperienced workers hired as the labor force was expanded.

GOVERNMENT STRATEGIC STOCK PILE

During the first half of 1946, Government strategic stock-piling activities were confined entirely to the transfer of surplus materials to the stock pile. The transfers were made pursuant to Surplus

Property Administration Regulation 17 (November 16, 1945), implementing Section 22 of the Surplus Property Act of 1944. Expenditures during the first half totaled $227,782, of which $197,926 was for the transfer of surplus materials, $9,681 for handling previously purchased materials, and $20,175 for administration.

Activities during the second half were determined largely by passage of the Strategic and Critical Materials Stock-Piling Act July 23, 1946. (The text of the act was quoted in its entirety in Minerals Yearbook, 1945, pages 14–17.) Expenditures during the second half of 1946 totaled $1,270,938, of which $440,540 was expended for materials, $768,512 for freight, handling, storage, and inspection, and $61,886 for administration.

As of August 1946, the stock-piling program included 31 materials—mineral, animal, and vegetable. Procurement plans at that time omitted 9 materials because relatively large quantities were already in the stock pile or anticipated as a result of transfer of surplus property. An additional 23 materials were omitted because procurement at the time would have interfered with the concurrent needs of industry.

Strategic and critical materials are defined by the Munitions Board as "those materials required for essential uses in a war emergency, the procurement of which in adequate quantities, quality, and time is sufficiently uncertain for any reason to require prior provisions for the supply thereof." The strategic list, determined by the Munitions Board as of the end of 1946, included the following mineral products in group A—those strategic and critical materials for which stock-piling is deemed the only satisfactory means of insuring an adequate supply for a future emergency:

Antimony
Asbestos:
  Chrysotile
  Amosite
Bauxite
Beryl
Bismuth
Cadmium
Celestite
Chromite:
  Metallurgical grade
  Refractory grade:
    Rhodesian origin
    Other origin
Cobalt
Columbite
Copper
Corundum
Diamonds, industrial
Graphite:
  Amorphous lump
  Flake
Iodine
Jewel bearings:
  Instrument jewels (except V jewels), sapphire and ruby V jewels, watch and timekeeping device jewels
Kyanite
Lead
Manganese ore:
  Battery grade
  Metallurgical grade
Mercury
Mica:
  Muscovite block and film (good stained and better)
Mica—Continued
  Muscovite splittings
  Phlogopite splittings
Monazite
Nickel
Platinum-group metals:
  Iridium
  Platinum
Quartz crystals
Rutile
Sapphire and ruby
Talc, steatite, block or lava
Tantalite
Tin
Tungsten
Vanadium
Zinc
Zirconium ores:
  Baddeleyite
  Zircon

Group B mineral products—"practicable for stock-piling, but recommended for acquisition only to the extent available for transfer from Government agencies because adequacy of supply can be insured either by stimulation of existing North American production or by partial or complete use of available substitutes"—on the strategic list at the end of 1946 were: Aluminum, barite, English chalk, chemical-grade chromite, natural cryolite, diamond dies, emery, acid-grade and

metallurgical-grade fluorspar, crystalline graphite fines, magnesium, muscovite block (stained and lower) and phlogopite block mica, molybdenum, platinum-group metals—osmium, palladium, rhodium, and ruthenium—selenium, and ground steatite talc.

Group C mineral products—not now recommended for stock-piling—on the strategic list at the end of 1946 were: Canadian chrysotile asbestos, optical glass, iron ore, petroleum and petroleum products, radium, iron and steel scrap, and uranium. Uranium had been omitted from previous strategic lists for reasons of security; it was added to group C rather than group A because it was not entirely clear which Government agency would be responsible for its stock-piling.

GOVERNMENT ORGANIZATION FOR RECONVERSION

Office for Emergency Management.—Within the framework of the Executive Office of the President was established in 1940 the Office for Emergency Management, which subsequently embraced most of the war agencies. At the end of 1946 the Office for Emergency Management was comprised of the following agencies: Office of Temporary Controls, War Assets Administration, Office of Defense Transportation, Office of Scientific Research and Development, and Philippine Alien Property Administration.

OFFICE OF TEMPORARY CONTROLS

The Office of Temporary Controls was established within the Office for Emergency Management by Executive Order 9809 of December 12, 1946, consolidating into one agency the Office of War Mobilization and Reconversion, Office of Economic Stabilization, Civilian Production Administration, and Office of Price Administration. John R. Steelman was appointed in June 1946 to succeed John W. Snyder as Director of OWMR. The functions of OES were transferred to OWMR September 20, 1945, and remained there during 1946 (except for a period of reestablished independence February 21 to July 25).

Civilian Production Administration.—As of fall 1946, the members of the Civilian Production Administration dealing with policy or administration affecting the mineral industries were as follows:

Administrator	John D. Small
Deputy Administrator	Philip F. Maguire
Deputy Administrator	John C. Houston, Jr.
Deputy Administrator	Frank R. Creedon
Deputy Administrator for Small Business	Laurence F. Arnold
General Counsel	Harold L. Price
Office of Labor Requirements, Director	Ralph Hetzel
Office of Economic Review and Analysis, Director.	Robert E. Johnson
Office of Information, Director	Karl Keyerleber
Bureau of Industry Operations, Director	Fred Glover
Metals and Minerals Division, Director	Frank H. Hayes
Deputy Director	John J. Croston
Premium Price Quota Committee:	
Chairman	John J. Croston
Secretary	Landon F. Strobel
Steel Branch, Chief	Patrick J. Treacy
Copper Branch, Chief	D. L. Forrester
Tin, Lead, and Zinc Branch, Chief	Erwin Vogelsang
Aluminum and Magnesium Branch, Chief	Robert L. Sebastian
Cork, Asbestos, and Fibrous Glass Branch, Chief.	Ray H. Coultrap
Miscellaneous Minerals and Mining Branch, Chief.	Fred G. Rockwell

Office of Price Administration.—Price controls on minerals were relaxed during the first 10 months of 1946 and were removed entirely on November 12 (effective November 10). As of fall 1946, the Office of Price Administration included the following officials:

Administrator	Paul A. Porter
Industrials Price Division, Director	Frederick C. Holder
Metals Price Branch, Price Executive	Warren M. Huff
Assistant Price Executive	Addison T. Cutler
Building and Construction Price Division, Director.	Allen Coe
Building Materials Price Branch, Price Executive.	Julian A. Littau

WAR ASSETS ADMINISTRATION

Executive Order 9689 of January 31, 1946, effective March 25, established the War Assets Administration and transferred to it the surplus property functions of the Reconstruction Finance Corporation. The staff of WAA, as of December 1, 1946, included the following:

Administrator	Robert M. Littlejohn
Associate Administrator	Robert M. Field, Acting
Office of General Disposal, Deputy Administrator.	Morton M. Boyd
Sales Group II	H. W. Cornell
General Industrial Equipment	John H. Williams, Acting
Metal Sales Division	Wm. H. Kelley
Materials and Supplies	Roland P. Brown, Acting
Metal-Working Equipment	C. A. Barrett, Acting
Office of Real Property Disposal, Deputy Administrator.	John J. O'Brien
Industrial	E. J. Ellingson
Office of Aircraft Disposal, Deputy Administrator.	John H. Carey, Acting
Maintenance and Salvage Sales	R. G. Lockwood

ATOMIC ENERGY COMMISSION

The Atomic Energy Act of 1946 (Public Law 585, 79th Congress), approved August 1, provided for the establishment of an Atomic Energy Commission with very broad powers of control over both the military and industrial production and utilization of atomic energy. An abstract of the Act is contained in the Uranium and Thorium chapter of this volume. The five members of the AEC were appointed by President Harry S. Truman October 28, 1946, and held their first formal meeting November 13 at Oak Ridge, Tenn. At the end of 1946 the organization of the Commission was as follows:

Members	David E. Lilienthal, Chairman
	Robert F. Bacher
	Sumner T. Pike
	Lewis L. Strauss
	William W. Waymack

793065—48——2

General Advisory Committee	J. Robert Oppenheimer, Chairman
	James B. Conant
	Lee A. DuBridge
	Enrico Fermi
	Isidor I. Rabi
	Hartley Rowe
	Glenn T. Seaborg
	Cyril S. Smith
	Hood Worthington
General Manager	Carroll L. Wilson
Division of Research, Director	James B. Fisk
Division of Production, Director	Walter J. Williams
Organization and Personnel, Director	G. Lyle Belsley
General Counsel	Herbert S. Marks
Military Liaison Committee	Lt. Gen. Lewis H. Brereton, Chairman
	Maj. Gen. Lunsford E. Oliver
	Col. John H. Hinds
	Rear Adm. Thorvald A. Solberg
	Rear Adm. Ralph A. Ofstie
	Rear Adm. William S. Parsons

UNITED STATES DEPARTMENT OF THE INTERIOR

Solid Fuels Administration for War.—Executive Order 9847 of May 6, 1947, provided for termination of the Solid Fuels Administration for War, effective June 30. The executive heads of the principal units of SFAW in March 1947 were as follows:

Administrator	Julius A. Krug
Deputy Administrator	Dan H. Wheeler
Assistant Deputy Administrator	Harlen M. Chapman
Assistant Deputy Administrator	N. O. Wood, Jr.
Assistant Deputy Administrator (heads Bituminous Distribution Division).	Walter P. Neekamp
Assistant Deputy Administrator (heads Anthracite Distribution Division).	Thomas G. Valleau
General Counsel (heads Legal and Compliance Division).	Thomas J. O'Brien
Production, Conservation and Information Division.	William J. Dougherty
Field Office Division	William B. Roberts III
Budget and Administrative Services Division	Mabel S. Bush
Personnel Division	Julia Carpin

Coal Mines Administration.—The Coal Mines Administration functioned from July 1943 to August 1944, after which its duties were assumed by SFAW. However, Executive Order 9728 of May 21, 1946, reestablished the Coal Mines Administration to direct the operation of those bituminous-coal mines that the Government took possession of to maintain maximum production. On May 29 Secretary of the Interior Julius A. Krug, as Coal Mines Administrator, and the United Mine Workers of America entered into an agreement covering the terms and conditions of employment for the period of Government

possession. The Coal Mines Administration, as of March 1947, was staffed largely by the United States Naval Reserve and included the following:

Administrator	Capt. N. H. Collison
Executive Officer	Comdr. E. D. Doyle
General Counsel	W. Randall Compton
Labor Relations Division	Burr Dailey
Production and Operation Division	Lt. Comdr. Charles M. Stull
Statistical Division	Lt. Comdr. Harold F. Hayes
Medical Survey Group, Director	Rear Adm. J. T. Boone
Administrative Aide to Director	Comdr. J. H. Balch
Fiscal Division	Lt. Comdr. J. N. Franz
Administration and Records	Lt. Erma H. Nash

Petroleum Administration for War. Oil and Gas Division.—The Petroleum Administration for War, an emergency agency established outside of the executive departments but with the Secretary of Interior as Administrator ex officio, was terminated by Executive Order 9718 of May 3, 1946, effective May 8. In its place the Oil and Gas Division, United States Department of the Interior, was established under authority of a letter from President Harry S. Truman dated May 3, 1946, and order of Secretary of the Interior Julius A. Krug dated May 6, 1946. The Division is authorized to coordinate and unify Federal petroleum policy and administration with a view to the conservation of the petroleum and natural-gas resources of the Nation and the achievement of petroleum security. Ralph K. Davies, Deputy Petroleum Administrator of PAW, was Acting Director of the Oil and Gas Division until December 23, 1946. The principal officials at the end of the year were:

Director	Max W. Ball
Assistant Director and Chief Counsel	Robert E. Friedman
Assistant Director	Edward B. Swanson
Administrative Officer	E. J. Skidmore

RECONSTRUCTION FINANCE CORPORATION

The Reconstruction Finance Corporation, together with such agencies as the U. S. Commercial Company and the War Damage Corporation, compose the Federal Loan Agency, of which Charles B. Henderson was Acting Administrator during 1946. The RFC is authorized to make loans to mines and smelters, to deal in strategic materials (purchases of minerals limited largely to tin concentrates after passage of the Stock-Piling Act July 23, 1946), to terminate war contracts, and to declare Government war plants surplus and available for disposal. These functions were being supervised by the following RFC officials at the end of 1946:

Board of Directors	Charles B. Henderson, Chairman
	Henry T. Bodman
	John D. Goodloe
	Harvey J. Gunderson
	Henry A. Mulligan

Secretary	Alfred T. Hobson
General Counsel	James L. Dougherty
Treasurer	William C. Beck, Jr.
Special Assistant to the Board of Directors	George F. Buskie
Controller	Harold W. H. Burrows
Statistical and Economic Division, Chief	David C. Elliott
Small Business Division, Acting Chief	Chauncey Y. Dodds
Division of Information, Chief	Arthur B. Merritt
Office of Metals Reserve, Executive Director	Morris Levinson
Deputy Directors	George S. Jewett
	Severt H. Petterson
	Jesse C. Johnson
Chief Counsel	Harold W. Sheehan
Office of Defense Supplies, Executive Director	Stuart K. Barnes
Associate Director and Chief Counsel	George B. Stoner
Deputy Directors	Henry D. Brite
	Charles A. Jostes
Office of Defense Plants, Executive Director	Frank T. Ronan
Associate Director	James L. Kelehan
Deputy Director in Charge of Engineering	Adolphus W. Greely
Deputy Director in Charge of Plant Servicing	Herbert R. Rutland
Chief Counsel	James G. Boss

Statistical Summary of Mineral Production

(General United States Summary and Detailed Production by States)

By JOHN HOZIK[1]

	PAGE		PAGE
Statistical procedure	13	General tables—Continued.	
General tables	15	States and principal mineral products	28
Production, by minerals	15	Prices of gold, silver, copper, lead, and zinc	29
Production, by mineral groups	19	State tables	30
Production, by States	20		
Mineral products and principal producing States	21		

THIS statistical summary corresponds in form and content with those presented in preceding editions of Minerals Yearbook. The tables showing the principal States producing each mineral product and listing the leading mineral products of each State have, for the first time, been made contemporaneous with the rest of the volume; to preserve the continuity of that series, data are presented for 1945 as well as for 1946. The fuel figures for 1946, except for Pennsylvania anthracite, are preliminary.

STATISTICAL PROCEDURE

Coverage.—Statistics used in this chapter to derive total mineral production of the United States and of individual States represent primary products only. Insofar as practicable the figures pertain to production exclusively from domestic mines. Geographically, the figures represent the 48 States, the District of Columbia, the Philippine Islands (through 1945 only), and the Territories of Alaska, Hawaii, and Puerto Rico. Data for United States possessions such as the Canal Zone, Guam, and Virgin Islands are not compiled.

Units of Measurements.—In expressing quantities of minerals, the Bureau of Mines has adopted the weight units (or in some instances, the volume or piece units) commonly employed by each individual industry. The unit of value is the United States dollar. No adjustment is made for variations in the purchasing power of the dollar.

Stage of Production Measured.—Measuring the total mineral production of the United States and individual States at the crude ore stage (rather than at the refined stage) would provide statistics most indicative of mine and well output. However, totals have not been

[1] K. Joyce D'Amico assisted considerably in the preparation of this chapter.

derived strictly for the crude stage alone, largely because of the impracticality of obtaining meaningful values for ores of gold, silver, copper, lead, and zinc. Instead, the State totals in this chapter represent each mineral at the earliest stage of production for which a value is reported. The United States totals are on the same basis, except that they include iron, ferro-alloy metals, and aluminum valued at the smelter rather than at the mine.

Relationship of United States Totals to State Totals.—The total of United States mineral production differs from the sum of those of the 48 States, the District of Columbia, and Alaska in that the former include: (1) Pig iron valued at the smelter instead of iron ore at the mine; (2) aluminum and ferro-alloy metals valued at the smelter and regardless of whether from foreign or domestic ores; (3) gold, silver, copper, lead, and zinc mint and smelter production rather than mine output; (4) certain lead and zinc pigments—sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide—and certain smelter and refinery byproducts, such as arsenic, bismuth, cadmium, minor metals, and sulfuric acid, whose States of origin are not reported, and (5) data for Hawaii, the Philippine Islands (through 1945), and Puerto Rico.

Elimination of Duplication.—In numerous instances in the tables of this chapter, production is shown both in the crude and in the refined stages, but in virtually every instance duplication is eliminated by including in the totals the value of each mineral at one stage only. For example, the values of coke made from coal, oil asphalt from petroleum, and lead and zinc pigments from metal are excluded from the totals. Likewise (but in these instances discounting the crude material rather than the refined product), the values of clay used in making heavy clay products or cement and of limestone used in making lime or cement are excluded from the totals.

GENERAL TABLES

Mineral products of the United States, 1944–46 [1]

Product		1944		1945		1946	
		Quantity	Value	Quantity	Value	Quantity	Value
METALLIC							
Aluminum	short tons (2,000 pounds)	776,446	$222,416,000	495,060	$140,864,000	409,630	$115,812,000
Antimonial lead	do	[2] 57,902	[2]	[2] 56,495	[2]	[2] 50,480	[2]
Antimony:							
Metal	do	[3]	[3]	[3]	[3]	[3]	[3]
Ore and concentrates	do	13,501	563,296	14,966	561,630	13,962	797,715
Bauxite (dried equivalent)	long tons (2,240 pounds)	2,823,724	14,402,497	981,009	5,591,084	1,072,825	6,709,164
Beryllium concentrates	short tons	388	56,135	39	6,133	100	17,787
Cadmium:							
Metal	pounds	8,551,424	6,435,124	7,988,658	6,106,992	6,180,265	6,094,572
In compounds	do	285,203	213,902	451,050	347,308	270,789	267,033
Chromite	short tons	45,629	1,668,299	13,973	532,382	4,107	105,041
Copper [4]	do	1,003,379	[5] 236,797,000	782,726	[5] 184,723,000	599,656	[5] 172,701,000
Ferro-alloys	do	1,860,956	246,014,039	1,661,657	210,509,657	1,551,624	176,273,655
Gold [6]	troy ounces	1,022,238	35,778,330	928,893	32,511,255	1,462,354	51,182,390
Iron:							
Ore [7]	long tons	95,135,675	[7] 256,885,512	88,136,715	[7] 243,760,986	70,090,410	[7] 215,006,427
Pig	short tons	60,995,977	1,278,981,313	53,265,353	1,172,435,165	45,075,890	1,103,928,986
Lead (refined) [4]	do	394,443	[5] 50,489,000	356,535	[5] 45,636,000	293,309	[5] 49,276,000
Magnesium (new ingot)	do	146,585	60,141,437	43,496	17,874,418	8,916	3,654,164
Manganese ore (35 percent or more Mn)	do	247,616	9,014,875	182,337	7,320,309	143,635	4,811,068
Manganiferous ore (5 to 35 percent Mn)	do	1,487,612	3,855,946	1,522,854	3,513,666	1,171,183	3,126,711
Mercury:							
Metal	flasks (76 pounds net)	37,688	4,460,752	30,763	4,149,621	25,348	2,490,188
Ore	short tons	[8]	[9]	[8]	[9]	[8]	[9]
Molybdenum	pounds	39,428,000	27,999,000	32,524,000	23,107,000	16,304,000	11,167,000
Nickel	short tons	988	[10]	1,155	[10]	352	[10]
Ores (crude), old tailings, etc.:							
Copper	do	91,064,000	[9]	76,856,000	[9]	61,741,000	[9]
Dry and siliceous (gold and silver)	do	2,620,000	[9]	1,984,000	[9]	2,995,000	[9]
Lead	do	6,805,000	[9]	6,730,000	[9]	5,651,000	[9]
Lead-copper	do	123,000	[9]	168,000	[9]	144,000	[9]
Zinc	do	16,470,000	[9]	16,308,000	[9]	14,895,000	[9]
Zinc-copper	do	943,000	[9]	812,000	[9]	654,000	[9]
Zinc-lead	do	15,418,000	[9]	12,355,000	[9]	12,730,000	[9]
Zinc-lead-copper	do	19,000	[9]	12,000	[9]	12,000	[9]
Platinum metals (refined) (value at New York City)	troy ounces	33,021	1,481,000	33,592	1,543,000	30,237	1,802,000

See footnotes at end of table.

Mineral products of the United States, 1944–46 [1]—Continued

Product	1944		1945		1946	
	Quantity	Value	Quantity	Value	Quantity	Value
METALLIC—continued						
Selenium ..... pounds	423,906	[10]	604,445	[10]	405,226	[10]
Silver [11] ..... troy ounces	35,651,049	$25,351,855	29,063,255	$20,667,205	21,103,269	[12] $17,051,441
Tantalum and columbium concentrates ..... pounds	10,412	24,234	6,649	13,653	3,475	8,793
Tellurium ..... do	45,323	[10]	60,328	[10]	38,523	[10]
Tin (metallic equivalent) ..... short tons	6	6,200				
Titanium concentrates:						
Ilmenite ..... do	280,791	7,371,279	308,518	7,359,170	282,708	4,878,917
Rutile ..... do	6,770	1,088,112	6,837	869,920	7,514	996,989
Tungsten concentrates (60 percent WO_3 basis) ..... do	10,283	14,407,143	5,534	7,692,691	5,193	6,283,413
Vanadium ..... pounds	3,527,054	1,689,578	2,963,913	1,766,500	1,272,148	710,582
Zinc [4] ..... short tons	574,453	[8] 98,806,000	467,084	[8] 80,338,000	459,205	[8] 81,738,000
Other metallic [13]		2,570,783		2,942,953		2,188,299
Total value of metallic products (approximate)		2,340,000,000		1,974,000,000		1,823,000,000
NONMETALLIC						
Arsenious oxide ..... short tons	34,472	1,696,819	24,810	1,197,061	12,476	678,419
Asbestos ..... do	6,667	380,334	12,226	446,045	14,075	504,764
Asphalt:						
Native ..... do	789,516	3,691,279	703,873	3,816,471	845,898	4,262,886
Oil (including road oil) [7] ..... do	6,408,766	[7] 70,310,623	6,311,815	[7] 68,930,149	7,056,882	[7] 82,910,877
Barite (crude) ..... do	518,617	3,558,489	696,062	5,348,652	724,362	5,242,755
Boron minerals ..... do	277,586	6,579,587	325,935	7,635,365	430,689	9,575,866
Bromine ..... pounds	102,112,462	19,712,819	79,709,857	14,796,229	42,783,327	8,560,434
Calcium-magnesium chloride ..... short tons	200,964	1,621,227	218,320	1,818,219	262,147	2,278,954
Cement ..... barrels (376 pounds net)	95,592,155	151,996,646	107,833,108	175,430,858	172,100,699	296,548,504
Clay:						
Products, heavy clay (other than pottery and refractories)		[14] 65,472,000		[14] 86,275,352		[14] 178,756,000
Raw ..... short tons	[15] 6,275,140	[15] 23,524,998	[15] 18,627,607	[15] 39,795,315	[15] 30,265,194	[15] 57,160,315
Coal:						
Bituminous [16] ..... do	619,576,240	1,810,900,542	577,617,327	1,768,204,320	532,000,000	1,806,153,000
Pennsylvania anthracite ..... do	63,701,363	354,582,884	54,933,909	323,944,435	60,506,873	413,417,070
Coke [7] ..... do	74,037,817	[7] 527,921,506	67,308,181	[7] 508,540,042	58,497,848	[7] 486,729,382
Diatomite ..... do	[17]	[17]	[17]	[17]	[17]	[17]
Emery ..... do	6,940	64,858	7,856	75,977	6,188	62,099
Feldspar (crude) ..... long tons	327,408	1,813,937	373,054	2,021,529	508,380	2,594,099
Fluorspar ..... short tons	413,781	12,503,487	323,961	9,896,879	277,940	9,038,969

Fuller's earth	do	294,737	3,297,064	296,368	3,463,913	298,752	3,702,993
Garnet for abrasive purposes	do	[17]	[17]	6,306	375,198	7,743	570,186
Gem stones			[18]		[18]		[18]
Graphite (amorphous and crystalline)	short tons	5,768	349,663	5,334	289,207	4,844	252,596
Grindstones and pulpstones	do	[17]	[17]	[17]	[17]	11,677	505,324
Gypsum (crude)	do	3,761,234	6,450,767	3,811,723	6,984,324	5,629,398	12,441,829
Helium [19]	cubic feet	137,268,144	872,551	128,440,909	937,283	63,403,345	478,654
Iodine	pounds	[17]	[17]	[17]	[17]	[17]	[17]
Kyanite	short tons	[17]	[17]	[17]	[17]	[17]	[17]
Lime	do	6,473,563	48,698,162	5,920,579	45,918,468	5,992,700	51,032,517
Lithium minerals	do	13,319	552,977	2,446	285,520	3,065	303,892
Magnesite (crude)	do	561,450	4,407,461	336,458	2,324,957	324,640	2,225,850
Magnesium compounds (natural) (including brucite)	pounds	1,023,158,000	18,393,960	539,612,000	9,675,149	430,744,000	8,316,300
Marl:							
Calcareous	short tons	178,036	171,599	154,122	188,311	213,448	248,530
Greensand	do	4,908	505,651	4,986	477,919	5,140	424,900
Mica:							
Scrap	do	51,727	1,089,072	41,060	812,322	53,602	1,041,423
Sheet	pounds	1,523,313	3,262,711	1,298,587	737,342	1,078,867	217,955
Millstones			9,700		15,018		14,780
Mineral pigments:							
Natural pigments and manufactured iron oxide pigments	short tons	97,018	8,016,452	101,014	8,825,174	115,097	10,004,150
Zinc and lead pigments [20]	do	211,403	28,991,887	194,448	26,555,658	[20] 225,822	[20] 32,354,517
Mineral waters	gallons sold	[18]	[18]	[18]	[18]	[18]	[18]
Natural gas	M cubic feet	3,711,039,000	797,255,000	3,918,686,000	837,852,000	4,095,000,000	885,032,000
Natural gasoline and allied products:							
Natural gasoline and cycle products	gallons	3,031,308,000	148,200,000	3,290,949,000	145,570,000	3,435,535,000	142,900,000
Liquefied petroleum gases	do	1,170,624,000	34,300,000	1,413,224,000	41,994,000	1,400,877,000	36,100,000
Oilstones, etc	short tons	[17]	[17]	[17]	[17]	[17]	[17]
Olivine	do	3,270	35,207	[17]	[17]	7,649	92,868
Peat	do	97,000	878,000	107,000	821,000	140,707	1,006,231
Petroleum	barrels (42 gallons)	1,677,904,000	2,032,960,000	1,713,655,000	2,094,250,000	1,733,424,000	2,441,810,000
Phosphate rock	long tons	5,376,643	20,856,429	5,806,723	23,951,077	6,860,713	31,043,821
Potassium salts	short tons	[21] 817,892	29,487,413	[21] 870,370	30,313,919	[21] 928,374	32,175,716
Pumice	do	88,757	704,110	157,011	1,051,037	319,883	1,585,753
Pyrites	long tons	788,530	2,598,000	722,596	2,700,000	813,372	3,228,000
Salt (sodium chloride)	short tons	15,717,171	43,715,492	15,394,141	43,914,406	15,132,145	44,912,586
Sand and gravel:							
Glass sand	do	4,443,031	8,227,502	4,681,920	8,374,218	4,848,602	9,541,405
Sand (molding, building, etc.) and gravel	do	190,340,000	116,936,000	190,842,000	120,463,000	249,282,000	161,845,000
Silica (quartz)	do	82,379	286,478	57,764	236,803	73,179	293,852
Slate	do	477,840	5,004,195	551,890	5,658,913	759,770	8,844,106
Sodium salts (carbonates and sulfates) (natural)	do	353,749	4,447,225	372,241	4,559,277	414,406	5,122,499
Stone [22]	do	155,579,580	175,642,157	153,405,210	179,307,902	178,852,360	234,339,486
Sulfur	long tons	3,519,083	56,300,000	3,833,294	61,300,000	4,128,212	66,100,000
Sulfuric acid (60° Baumé) (byproduct) [23]	short tons	1,160,023	10,415,587	1,084,891	10,136,598	922,127	8,226,751
Talc, pyrophyllite, and ground soapstone [22]	do	398,863	5,017,462	398,384	5,407,235	457,066	6,445,344

See footnotes at end of table.

Mineral products of the United States, 1944–46 [1]—Continued

Product		1944		1945		1946	
		Quantity	Value	Quantity	Value	Quantity	Value
NONMETALLIC—continued							
Tripoli	short tons	18,425	$301,863	18,247	$306,829	28,955	$549,099
Vermiculite	do	54,116	541,744	64,808	648,077	86,390	867,973
Other nonmetallic [24]			4,511,391		4,224,387		4,636,078
Total value of nonmetallic products (approximate)			6,077,000,000		6,166,000,000		7,036,000,000
SUMMARY							
Total value:							
Metallic			2,340,000,000		1,974,000,000		1,823,000,000
Nonmetallic:							
Fuels			5,178,000,000		5,212,000,000		5,725,000,000
Other			899,000,000		954,000,000		1,311,000,000
Grand total approximate value of mineral products			8,417,000,000		8,140,000,000		8,859,000,000

[1] In this general statement certain of the figures represent shipments rather than quantity mined, and some of the figures for 1946 are subject to revision. For details see following chapters of this volume.

[2] Figures represent antimonial lead produced at primary refineries from both domestic and foreign primary and secondary sources; no figures for value of antimonial lead available. Estimate of value of primary antimony and lead contents of antimonial lead from domestic sources included in total value of metallic products.

[3] Largely from foreign ore; value not included in total value.

[4] Product from domestic ores only.

[5] Value does not include premiums paid to miners by the Government. Total overceiling payments for copper, lead, and zinc amounted to approximately $83,000,000 in 1944, $79,000,000 in 1945, and $77,000,000 in 1946.

[6] According to Bureau of the Mint. Valued at $35 per ounce.

[7] Value not included in total value.

[8] Figures not available.

[9] Figures showing values not available.

[10] Value included in total value of metallic products; Bureau of Mines not at liberty to publish figures.

[11] According to Bureau of the Mint.

[12] Calculated by Bureau of Mines at $0.808 per fine ounce, based on Treasury buying price for newly mined silver in 1946 as follows: January 1 to June 30, $0.71111111; July 1 to December 31, $0.905.

[13] Includes value of following products; figures are shown wherever Bureau of Mines is at liberty to publish them: Bismuth, cobalt (556,687 pounds in 1944), germanium, indium (1944—82,427 troy ounces, $391,973; 1945—57,434 ounces, $146,139; 1946—9,667 ounces, $16,618), thallium, and zircon.

[14] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.

[15] 1944: Sold or shipped; 1945–46: Sold or used—value of clay used in cement and heavy clay products not included in total value for State.

[16] Includes brown coal and lignite, and anthracite mined elsewhere than in Pennsylvania.

[17] Value included in total value of nonmetallic products; Bureau of Mines not at liberty to publish figures.

[18] No canvass. Estimate of value included in total value of nonmetallic products.

[19] Figures cover fiscal year ended June 30 of year stated.

[20] Includes sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide except that in 1946 data for sublimed blue and white lead are excluded from this grouping; however, the value is included in the total value of nonmetallic products.

[21] Equivalent as K_2O.

[22] Figures for soapstone used as dimension stone included in figures for stone.

[23] From copper, lead, and zinc smelters and zinc roasters.

[24] Includes value of following products. Figures are shown wherever Bureau of Mines is at liberty to publish them.

1944: Andalusite, crude aplite, natural sulfonated bitumen, calcite (Iceland spar) (5,748 pounds, $57,480), corundum, dumortierite, flint lining for tube mills (2,063 short tons, $38,833), pebbles for grinding (8,012 short tons, $172,418), quartz crystal (3,934 pounds, $23,769), silica sand and sandstone (ground) (558,606 short tons, $3,989,981), strontium minerals (3,005 short tons, $48,165), sulfur ore (1,639 long tons, $8,950), industrial topaz, and wollastonite.

1945: Andalusite, crude aplite, dumortierite, flint lining for tube mills (1,982 short tons, $45,933), pebbles for grinding (8,615 short tons, $201,806), silica sand and sandstone (ground) (533,656 short tons, $3,709,597), strontium minerals (2,784 short tons, $27,840), sulfur ore (1,426 long tons, $12,170), industrial topaz, and wollastonite.

1946: Crude aplite, flint lining for tube mills (2,375 short tons, $44,247), pebbles for grinding (4,652 short tons, $102,043), perlite (4,206 short tons, $23,133), silica sand and sandstone (ground) (575,888 short tons, $4,125,398), strontium minerals (243 short tons, $3,726), sulfur ore (6,344 long tons, $95,531), industrial topaz, and wollastonite.

Value of mineral products of the United States, 1880–1946 [1]

Year	Metallic	Nonmetallic			Grand total
		Fuels [2]	Other	Total	
1880 [1]	$190,881,000	$120,241,000	$56,341,000	$176,582,000	$367,463,000
1881	192,663,000	149,798,000	60,659,000	210,457,000	403,120,000
1882	219,070,000	170,479,000	63,557,000	234,036,000	453,106,000
1883	201,131,000	185,760,000	61,170,000	246,930,000	448,061,000
1884	182,784,000	165,825,000	58,431,000	224,256,000	407,040,000
1885	174,718,000	183,075,000	61,758,000	244,833,000	419,551,000
1886	204,795,000	184,608,000	66,782,000	251,390,000	456,185,000
1887	241,183,000	217,251,000	77,199,000	294,450,000	535,633,000
1888	242,460,000	231,459,000	79,880,000	311,339,000	553,799,000
1889	250,823,000	208,297,000	83,206,000	291,503,000	542,326,000
1890	303,937,000	230,962,000	80,530,000	311,492,000	615,429,000
1891	280,985,000	237,160,000	82,704,000	319,864,000	600,849,000
1892	284,215,000	248,344,000	89,673,000	338,017,000	622,232,000
1893	223,654,000	251,735,000	70,104,000	321,839,000	545,493,000
1894	187,335,000	235,618,000	127,292,000	362,910,000	550,245,000
1895	248,533,000	268,438,000	125,720,000	394,158,000	642,691,000
1896	252,575,000	268,161,000	120,305,000	388,466,000	641,041,000
1897	270,434,000	253,598,000	127,580,000	381,178,000	651,612,000
1898	308,747,000	267,513,000	150,782,000	418,295,000	727,042,000
1899	484,021,000	340,773,000	185,302,000	526,075,000	1,010,096,000
1900	514,232,000	406,376,000	188,328,000	594,704,000	1,108,936,000
1901	493,814,000	442,409,000	218,855,000	661,264,000	1,155,078,000
1902	605,017,000	469,079,000	253,855,000	722,934,000	1,327,951,000
1903	589,253,000	634,226,000	271,902,000	906,128,000	1,495,381,000
1904	501,314,000	584,043,000	273,824,000	857,867,000	1,359,181,000
1905	702,785,000	602,258,000	318,722,000	920,980,000	1,623,765,000
1906	886,280,000	652,398,000	362,202,000	1,014,600,000	1,900,880,000
1907	904,151,000	789,128,000	376,291,000	1,165,419,000	2,069,570,000
1908	550,890,000	716,034,000	324,849,000	1,040,883,000	1,591,773,000
1909	755,092,000	746,204,000	385,811,000	1,132,015,000	1,887,107,000
1910	750,027,000	828,213,000	409,604,000	1,237,817,000	1,987,844,000
1911	681,023,000	835,763,000	407,295,000	1,243,058,000	1,924,081,000
1912	862,191,000	945,541,000	430,062,000	1,375,603,000	2,237,794,000
1913	879,058,000	1,087,843,000	466,644,000	1,554,487,000	2,433,545,000
1914	687,101,000	992,837,000	431,234,000	1,424,071,000	2,111,172,000
1915	993,353,000	972,617,000	428,674,000	1,401,291,000	2,394,644,000
1916	1,622,129,000	1,332,584,000	553,726,000	1,886,310,000	3,508,439,000
1917	2,088,914,000	2,237,837,000	665,745,000	2,903,582,000	4,992,496,000
1918	2,156,588,000	2,736,151,000	647,969,000	3,384,120,000	5,540,708,000
1919	1,361,099,000	2,510,894,000	751,777,000	3,262,671,000	4,623,770,000
1920	1,763,675,000	4,192,910,000	1,024,755,000	5,217,665,000	6,981,340,000
1921	654,700,000	2,703,470,000	780,330,000	3,483,800,000	4,138,500,000
1922	988,100,000	2,737,880,000	921,310,000	3,659,190,000	4,647,290,000
1923	1,511,930,000	3,317,100,000	1,157,470,000	4,474,570,000	5,986,500,000
1924	1,233,370,000	2,898,630,000	1,173,800,000	4,072,430,000	5,305,800,000
1925	1,382,155,000	3,058,680,000	1,236,795,000	4,295,475,000	5,677,630,000
1926	1,405,345,000	3,541,916,000	1,266,339,000	4,808,255,000	6,213,600,000
1927	1,220,633,000	3,060,047,000	1,249,320,000	4,309,367,000	5,530,000,000
1928	1,288,290,000	2,884,962,000	1,211,948,000	4,096,910,000	5,385,200,000
1929	1,480,390,000	3,190,527,000	1,216,683,000	4,407,210,000	5,887,600,000
1930	985,790,000	2,764,500,000	1,014,510,000	3,779,010,000	4,764,800,000
1931	569,790,000	1,892,400,000	704,410,000	2,596,810,000	3,166,600,000
1932	285,875,000	1,743,400,000	432,425,000	2,175,825,000	2,461,700,000
1933	417,065,000	1,683,400,000	454,635,000	2,138,035,000	2,555,100,000
1934	548,934,000	2,233,300,000	543,166,000	2,776,466,000	3,325,400,000
1935	733,130,000	2,330,000,000	586,870,000	2,916,870,000	3,650,000,000
1936	1,081,600,000	2,759,200,000	716,000,000	3,475,200,000	4,556,800,000
1937	1,468,200,000	3,200,500,000	744,700,000	3,945,200,000	5,413,400,000
1938	892,600,000	2,820,300,000	650,300,000	3,470,600,000	4,363,200,000
1939	1,291,700,000	2,834,300,000	788,200,000	3,622,500,000	4,914,200,000
1940	1,678,600,000	3,116,500,000	818,800,000	3,935,300,000	5,613,900,000
1941	2,132,000,000	3,708,100,000	1,037,900,000	4,746,000,000	6,878,000,000
1942	2,363,900,000	4,103,400,000	1,109,000,000	5,212,400,000	7,576,300,000
1943	2,488,000,000	4,608,300,000	975,500,000	5,583,800,000	8,071,800,000
1944	2,340,000,000	5,178,000,000	899,000,000	6,077,000,000	8,417,000,000
1945	1,974,000,000	5,212,000,000	954,000,000	6,166,000,000	8,140,000,000
1946 [3]	1,823,000,000	5,725,000,000	1,311,000,000	7,036,000,000	8,859,000,000
Grand total	59,532,027,000	112,440,252,000	34,975,510,000	147,415,762,000	206,947,789,000

[1] Figures for earlier years not available.
[2] Coal, natural gas, natural gasoline and allied products, petroleum.
[3] Subject to revision.

Value of mineral products of the United States, 1942–46, and total, 1911–46, by States [1]

State	1942	1943	1944	1945	1946	1911–46 [1]		
						Total value	Rank	Percent of total for United States
Alabama	$100,222,752	$102,584,000	$109,149,000	$110,360,000	$117,764,000	$2,220,286,000	19	1.44
Alaska	20,094,260	9,055,000	6,903,000	10,174,000	12,430,000	739,158,000	31	.48
Arizona	117,990,899	124,584,000	115,592,000	98,574,000	118,055,000	3,345,847,000	13	2.18
Arkansas	60,337,118	81,249,000	68,681,000	63,256,000	69,881,000	1,219,858,000	26	.79
California	541,391,606	565,441,000	607,370,000	621,308,000	696,997,000	13,260,382,000	3	8.63
Colorado	95,278,822	88,534,000	80,202,000	77,458,000	77,960,000	2,208,827,000	20	1.44
Connecticut	5,054,812	4,835,000	4,496,000	3,498,000	5,584,000	166,414,000	42	.11
Delaware	402,273	367,000	182,000	131,000	491,000	13,950,000	50	.01
District of Columbia	600,000	100,000	111,000	229,000	710,000	20,665,000	49	.01
Florida	20,303,948	25,070,000	21,896,000	24,928,000	31,093,000	507,587,000	34	.33
Georgia	22,008,807	20,927,000	19,005,000	19,988,000	30,076,000	460,439,000	35	.30
Idaho	54,289,536	57,475,000	51,321,000	44,348,000	44,444,000	1,130,291,000	28	.74
Illinois	327,665,438	322,050,000	330,961,000	332,052,000	355,578,000	7,317,097,000	6	4.76
Indiana	89,571,417	83,513,000	90,465,000	89,856,000	107,800,000	2,749,959,000	15	1.79
Iowa	28,278,387	24,187,000	22,452,000	25,008,000	34,962,000	1,088,840,000	29	.71
Kansas	201,454,022	220,413,000	217,876,000	208,254,000	243,407,000	4,219,814,000	9	2.75
Kentucky	204,294,168	236,578,000	276,701,000	275,487,000	288,606,000	4,429,698,000	8	2.88
Louisiana	246,438,691	269,412,000	288,374,000	293,963,000	342,944,000	3,913,090,000	12	2.55
Maine	3,614,054	2,720,000	2,150,000	2,521,000	4,389,000	155,255,000	43	.10
Maryland	18,383,872	17,508,000	15,264,000	15,329,000	21,468,000	551,039,000	33	.36
Massachusetts	8,467,398	5,441,000	5,263,000	5,450,000	9,745,000	340,269,000	39	.22
Michigan	161,433,922	157,016,000	152,162,000	139,832,000	146,355,000	4,031,169,000	10	2.62
Minnesota	191,649,723	177,687,000	170,488,000	167,138,000	155,734,000	3,981,239,000	11	2.59
Mississippi	29,992,924	21,178,000	18,940,000	22,230,000	35,266,000	218,372,000	41	.14
Missouri	76,122,304	72,212,000	72,960,000	74,387,000	87,100,000	2,324,768,000	18	1.51
Montana	96,681,604	91,743,000	89,052,000	75,978,000	68,630,000	2,589,080,000	17	1.68
Nebraska	8,428,200	6,800,000	5,060,000	4,963,000	7,237,000	149,019,000	44	.10
Nevada	46,313,373	56,525,000	51,800,000	31,307,000	35,454,000	1,159,600,000	27	.75
New Hampshire	1,211,184	1,350,000	1,164,000	802,000	1,451,000	73,995,000	47	.05
New Jersey	38,921,351	37,583,000	33,828,000	31,267,000	33,518,000	1,658,021,000	23	1.08
New Mexico	106,811,195	123,805,000	124,827,000	118,947,000	129,044,000	1,684,034,000	21	1.10
New York	103,298,386	88,416,000	87,638,000	91,968,000	108,270,000	2,670,118,000	16	1.74
North Carolina	17,372,690	22,172,000	22,199,000	14,766,000	20,428,000	354,779,000	37	.23
North Dakota	4,028,008	4,422,000	4,393,000	4,578,000	5,587,000	98,933,000	46	.06
Ohio	175,548,629	189,422,000	192,194,000	196,756,000	243,637,000	6,386,212,000	7	4.16
Oklahoma	271,298,469	254,642,000	260,832,000	296,564,000	326,148,000	10,428,318,000	5	6.78
Oregon	14,065,572	12,267,000	9,657,000	9,463,000	11,783,000	236,460,000	40	.15
Pennsylvania	841,847,147	889,077,000	985,452,000	936,157,000	1,090,784,000	27,105,782,000	1	17.63
Rhode Island	836,040	808,000	612,000	508,000	561,000	31,450,000	48	.02
South Carolina	5,890,982	4,759,000	4,192,000	5,043,000	8,189,000	116,568,000	45	.08

South Dakota	24,139,283	8,608,000	5,472,000	7,139,000	18,410,000	444,557,000	36	.29
Tennessee	67,223,639	64,485,000	63,998,000	58,676,000	70,051,000	1,337,705,000	25	.87
Texas	909,203,286	1,103,390,000	1,319,266,000	1,359,603,000	1,518,111,000	17,187,055,000	2	11.18
Utah	146,968,512	164,150,000	149,558,000	129,314,000	96,774,000	2,935,852,000	14	1.91
Vermont	7,266,089	6,404,000	7,672,000	8,249,000	12,096,000	344,282,000	38	.22
Virginia	79,770,810	85,825,000	87,001,000	82,012,000	92,107,000	1,504,474,000	24	.98
Washington	35,659,543	37,593,000	36,483,000	31,301,000	33,076,000	780,706,000	30	.51
West Virginia	493,994,630	564,230,000	598,425,000	582,990,000	632,654,000	11,546,569,000	4	7.51
Wisconsin	17,998,036	18,930,000	22,798,000	22,217,000	28,596,000	600,432,000	32	.39
Wyoming	64,070,497	70,737,000	74,175,000	81,101,000	87,057,000	1,671,410,000	22	1.09

[1] In this table iron ore, not pig iron, is taken as the basis of iron valuation, and for other metals mine production (recoverable content of metals) is the basis. Comparable totals for years before 1911 not available.

Mineral products of the United States and principal producing States in 1945

Rank in value	Product	Principal producing States [1]	
		In order of quantity	In order of value
12	Aluminum	Washington, Tennessee, New York, Arkansas	Rank same as for quantity.
98	Andalusite	California	Do.
(2)	Antimonial lead	Not separable by States	Not separable by States.
70	Antimony ore	Idaho, Oregon, Nevada	Rank same as for quantity.
82	Aplite (crude)	Virginia	Do.
60	Arsenious oxide	Utah, Montana	Do.
74	Asbestos	Vermont, Arizona, North Carolina, Georgia	Vermont, Arizona, California, North Carolina.
	Asphalt:		
46	Native	Texas, Kentucky, Oklahoma, Utah	Utah, Kentucky, Texas, Oklahoma.
16	Oil	Not separable by States	Not separable by States.
43	Barite (crude)	Arkansas, Missouri, Georgia, California	Arkansas, Missouri, Georgia, Tennessee.
41	Bauxite	Arkansas, Georgia, Alabama, Virginia	Rank same as for quantity.
97	Beryllium concentrates	South Dakota, New Hampshire	Do.
59	Bismuth	Not separable by States	Not separable by States.
35	Boron minerals	California	Rank same as for quantity.
29	Bromine	Texas, North Carolina, Michigan, California	Texas, Michigan, North Carolina, California.
39	Cadmium	Not separable by States	Not separable by States.
54	Calcium-magnesium chloride	Michigan, West Virginia, California	Michigan, California, West Virginia.
11	Cement	Pennsylvania, California, Texas, Michigan	Rank same as for quantity.
71	Chromite	California, Oregon	Do.
	Clay:		
14	Products, heavy clay (other than pottery and refractories).		Ohio, Pennsylvania, Illinois, California.
21	Raw (sold or used by producers)	Ohio, Pennsylvania, Illinois, Missouri	Georgia, Pennsylvania, Ohio, Missouri.

See footnotes at end of table.

Mineral products of the United States and principal producing States in 1945—Continued

Rank in value	Product	Principal producing States [1]	
		In order of quantity	In order of value
2	Coal:		
	Bituminous	West Virginia, Pennsylvania, Illinois, Kentucky	West Virginia, Pennsylvania, Kentucky, Illinois.
	Pennsylvania anthracite	Pennsylvania	Rank same as for quantity.
58	Cobalt	Missouri, Pennsylvania	Do.
5	Coke	Pennsylvania, Ohio, Indiana, New York	Do.
9	Copper	Arizona, Utah, Montana, New Mexico	Do.
48	Diatomite	California, Oregon, Nevada, Washington	Do.
101	Dumortierite	Nevada	Do.
88	Emery	New York	Do.
53	Feldspar (crude)	North Carolina, South Dakota, New Hampshire, Virginia	Do.
7	Ferro-alloys	Pennsylvania, New York, Ohio, West Virginia	Pennsylvania, New York, West Virginia, Alabama.
90	Flint lining for tube mills	Minnesota, North Carolina, Wisconsin	Rank same as for quantity.
31	Fluorspar	Illinois, Kentucky, Colorado, New Mexico	Do.
50	Fuller's earth	Texas, Georgia, Florida, Illinois	Georgia, Texas, Florida, Illinois.
75	Garnet (abrasive)	New York, Idaho	Rank same as for quantity.
[2]	Gem stones	No canvass for 1945	No canvass for 1945.
99	Germanium	Not separable by States	Not separable by States.
22	Gold	Utah, California, Colorado, Nevada	Rank same as for quantity.
77	Graphite:		
	Amorphous	Rhode Island	Do.
	Crystalline	Texas, Alabama	Do.
72	Grindstones and pulpstones	Ohio, West Virginia	Do.
38	Gypsum (crude)	Michigan, New York, California, Iowa	New York, Virginia, California, Michigan.
63	Helium	Texas, Kansas	Kansas, Texas.
85	Indium	Not separable by States	Not separable by States.
67	Iodine (natural)	California	Rank same as for quantity.
	Iron:		
6	Ore	Minnesota, Michigan, Alabama, New York	Minnesota, Michigan, New York, Alabama.
3	Pig	Pennsylvania, Ohio, Indiana, Illinois	Rank same as for quantity.
80	Kyanite	Virginia	Do.
19	Lead	Missouri, Idaho, Utah, Arizona	Do.
18	Lime	Ohio, Pennsylvania, Missouri, West Virginia	Do.
78	Lithium minerals	California, North Carolina, Colorado, South Dakota	Do.
52	Magnesite (crude)	Washington, Nevada, California, Texas	Washington, California, Nevada, Texas.
28	Magnesium	Texas, Ohio, Michigan, Connecticut	Rank same as for quantity.
32	Magnesium compounds (natural)	Texas, California, Michigan, Nevada	Texas, California, Michigan, New Jersey.
37	Manganese ore	Montana, Virginia, Washington, Arkansas	Montana, Washington, Virginia, Arkansas.
49	Manganiferous ore	Minnesota, New Mexico, Arkansas, Montana	Rank same as for quantity.
66	Manganiferous zinc residuum	New Jersey	Do.
	Marl:		
84	Calcareous	Virginia, Indiana, Michigan, West Virginia	Virginia, West Virginia, Nevada, Michigan.
73	Greensand	New Jersey	Rank same as for quantity.
45	Mercury	California, Nevada, Oregon, Alaska	Do.

56	Mica	North Carolina, California, Colorado, South Dakota	North Carolina, South Dakota, New Hampshire, Idaho.
	Scrap	do	North Carolina, Colorado, South Dakota, Georgia.
	Sheet	North Carolina, New Hampshire, Connecticut, South Dakota	North Carolina, South Dakota, New Hampshire, Idaho.
93	Millstones		North Carolina, New York, Virginia, Minnesota.
	Mineral pigments:		
33	Natural pigments and manufactured iron oxide pigments.	Pennsylvania, Illinois, New Jersey, Virginia	Pennsylvania, New Jersey, Illinois, Virginia.
24	Lead and zinc pigments	Pennsylvania, Illinois, Kansas, Ohio	Rank same as for quantity.
(3)	Mineral waters	No canvass for 1945	No canvass for 1945.
26	Molybdenum	Colorado, Utah, New Mexico, Arizona	Rank same as for quantity.
4	Natural gas	Texas, Louisiana, California, Oklahoma	Texas, California, Louisiana, West Virginia.
8	Natural gasoline and allied products:		
	Natural gasoline and cycle products	Texas, California, Louisiana, Oklahoma	Rank same as for quantity.
	Liquefied petroleum gases	Texas, California, Oklahoma, Louisiana	Texas, California, Louisiana, Oklahoma.
68	Nickel	Not separable by States	Not separable by States.
81	Oilstones, etc	Arkansas, Ohio, New Hampshire, Indiana	Rank same as for quantity.
69	Olivine	North Carolina	Do.
(4)	Ores (crude), etc.:		
	Copper	Arizona, Utah, New Mexico, Michigan	Value not available.
	Dry and siliceous (gold and silver)	Colorado, South Dakota, Idaho, Nevada	Do.
	Lead	Missouri, Idaho, California, Utah	Do.
	Lead-copper	Missouri, Idaho, Arizona	Do.
	Zinc	Oklahoma, Kansas, Tennessee, Missouri	Do.
	Zinc-copper	Washington, California, Arizona, Colorado	Do.
	Zinc-lead	Idaho, Oklahoma, Kansas, Missouri	Do.
	Zinc-lead-copper	Arizona, Colorado	Do.
65	Peat	Maine, New Jersey, Florida, Ohio	Ohio, New Jersey, Michigan, California.
83	Pebbles for grinding	North Carolina, Minnesota, Wisconsin, Texas	Rank same as for quantity.
1	Petroleum	Texas, California, Oklahoma, Louisiana	Do.
25	Phosphate rock	Florida, Tennessee, Montana, Idaho	Do.
57	Platinum metals	Alaska, California, Oregon	Do.
23	Potassium salts	New Mexico, California, Utah, Maryland	Do.
62	Pumice	California, Kansas, Idaho, Nebraska	California, New Mexico, Kansas, Nebraska.
51	Pyrites	Tennessee, Virginia, California, Montana	Tennessee, Virginia, California, New York.
20	Salt	Michigan, New York, Ohio, Louisiana	Michigan, New York, Louisiana, Ohio.
13	Sand and gravel	California, Illinois, Michigan, Texas	California, Illinois, Ohio, Texas.
61	Selenium	Not separable by States	Not separable by States.
79	Silica (quartz)	Washington, California, Wisconsin, North Carolina	North Carolina, Washington, California, Wisconsin.
47	Silica sand and sandstone (ground)	Illinois, New Jersey, Pennsylvania, Ohio	Illinois, New Jersey, Ohio, Pennsylvania.
27	Silver	Idaho, Utah, Montana, Arizona	Rank same as for quantity.
40	Slate		Pennsylvania, Vermont, New York, Georgia.
44	Sodium salts (carbonates and sulfates) (natural)	California, Texas, Wyoming	Rank same as for quantity.
10	Stone	Pennsylvania, Michigan, Ohio, Illinois	Pennsylvania, Ohio, Illinois, New York.
92	Strontium minerals	Texas, California	Rank same as for quantity.
17	Sulfur	Texas, Louisiana	Do.
30	Sulfuric acid from copper, lead, and zinc smelters and zinc roasters.	Pennsylvania, Illinois, Tennessee, Indiana	Pennsylvania, Illinois, Tennessee, Utah.
96	Sulfur ore	Texas, Colorado	Rank same as for quantity.
42	Talc, pyrophyllite, and ground soapstone [5]	New York, North Carolina, California, Vermont	New York, California, Vermont, North Carolina.
94	Tantalum and columbium concentrates	New Mexico, North Carolina, South Dakota	Rank same as for quantity.

See footnotes at end of table.

Mineral products of the United States and principal producing States in 1945—Continued

Rank in value	Product	Principal producing States [1]	
		In order of quantity	In order of value
87	Tellurium	Not separable by States	Not separable by States.
91	Thallium	do	Do.
	Titanium concentrates:		
36	Ilmenite	New York, Florida, Virginia, North Carolina	Rank same as for quantity.
64	Rutile	Florida, Virginia	Do.
95	Topaz (industrial)	South Carolina	Do.
76	Tripoli	Illinois, Missouri, Pennsylvania	Do.
34	Tungsten concentrates	Idaho, Nevada, California, Colorado	Do.
55	Vanadium	Colorado, Idaho, Utah, Arizona	Do.
69	Vermiculite	Montana, South Carolina, Wyoming, Colorado	Do.
100	Wollastonite	New York	Do.
15	Zinc	Idaho, New Jersey, Oklahoma, Kansas	Idaho, Oklahoma, New Jersey, Kansas.
86	Zircon	Florida	Rank same as for quantity.

[1] Rank of States in metal production (except aluminum, ferro-alloys, and pig iron) arranged according to mine reports, not smelter output.
[2] Separate figures for antimonial lead from primary sources not available.
[3] No canvass for 1945. [4] Value not available. [5] Exclusive of soapstone used as dimension stone (all from Virginia), which is included in figures for stone.

Mineral products of the United States and principal producing States in 1946

Rank in value	Product	Principal producing States [1]	
		In order of quantity	In order of value
14	Aluminum	Washington, Tennessee, New York, Alabama	Rank same as for quantity.
(3)	Antimonial lead	Not separable by States	Not separable by States.
62	Antimony ore	Idaho, Washington, Nevada, Oregon	Rank same as for quantity.
83	Aplite (crude)	Virginia	Do.
67	Arsenious oxide	Montana, Utah	Do.
72	Asbestos	Vermont, Arizona, North Carolina, Georgia	Vermont, Arizona, California, North Carolina.
	Asphalt:		
45	Native	Texas, Oklahoma, Kentucky, Utah	Utah, Kentucky, Texas, Oklahoma.
15	Oil	Not separable by States	Not separable by States.
40	Barite (crude)	Arkansas, Missouri, Georgia, Tennessee	Missouri, Arkansas, Georgia, Tennessee.
36	Bauxite	Arkansas, Georgia, Alabama, Virginia	Rank same as for quantity.
93	Beryllium concentrates	South Dakota, New Hampshire	Do.
58	Bismuth	Not separable by States	Not separable by States.

30	Boron minerals	California	Rank same as for quantity.
33	Bromine	Texas, Michigan, California, West Virginia	Do.
38	Cadmium	Not separable by States	Not separable by States.
53	Calcium-magnesium chloride	Michigan, West Virginia, California	Michigan, California, West Virginia.
6	Cement	Pennsylvania, California, Texas, New York	Rank same as for quantity.
84	Chromite	Oregon, California	Do.
	Clay:		
10	Products, heavy clay (other than pottery and refractories).		Ohio, Pennsylvania, Illinois, California.
18	Raw (sold or used by producers)	Ohio, Pennsylvania, Illinois, Missouri	Georgia, Pennsylvania, Ohio, Missouri.
2	Coal:		
	Bituminous	West Virginia, Pennsylvania, Kentucky, Illinois	Rank same as for quantity.
	Pennsylvania anthracite	Pennsylvania	Do.
75	Cobalt	Pennsylvania, Missouri	Do.
5	Coke	Pennsylvania, Ohio, Indiana, New York	Do.
12	Copper	Arizona, Utah, Montana, New Mexico	Do.
44	Diatomite	California, Oregon, Nevada, Washington	Do.
88	Emery	New York	Do.
51	Feldspar (crude)	North Carolina, South Dakota, New Hampshire, Colorado	North Carolina, New Hampshire, South Dakota, Virginia.
11	Ferro-alloys	Pennsylvania, New York, Ohio, West Virginia	Pennsylvania, New York, West Virginia, Alabama.
90	Flint lining for tube mills	Minnesota, Wisconsin, North Carolina	Rank same as for quantity.
31	Fluorspar	Illinois, Kentucky, Colorado, New Mexico	Do.
47	Fuller's earth	Texas, Georgia, Florida, Illinois	Georgia, Texas, Florida, Illinois.
68	Garnet (abrasive)	New York, Idaho	Rank same as for quantity.
(4)	Gem stones	No canvass for 1946	No canvass for 1946.
91	Germanium	Not separable by States	Not separable by States.
19	Gold	California, South Dakota, Alaska, Utah	Rank same as for quantity.
81	Graphite:		
	Amorphous	Rhode Island	Do.
	Crystalline	Texas, Alabama, Pennsylvania	Do.
71	Grindstones and pulpstones	Ohio, West Virginia, Washington	Do.
27	Gypsum (crude)	Michigan, New York, Texas, California	Do.
73	Helium	Texas, Kansas	Do.
94	Indium	Not separable by States	Not separable by States.
63	Iodine (natural)	California	Rank same as for quantity.
	Iron:		
8	Ore	Minnesota, Michigan, Alabama, Utah	Minnesota, Michigan, Alabama, New York.
3	Pig	Pennsylvania, Ohio, Indiana, Illinois	Rank same as for quantity.
79	Kyanite	Virginia, Georgia, California	Do.
21	Lead	Missouri, Idaho, Utah, Arizona	Do.
20	Lime	Ohio, Pennsylvania, Missouri, West Virginia	Do.
77	Lithium minerals	California, South Dakota, New Mexico, Colorado	Do.
54	Magnesite (crude)	Washington, Nevada, California, Texas	Do.
48	Magnesium	Texas, Michigan, California	Do.
34	Magnesium compounds (natural)	Michigan, California, Nevada, New Jersey	Michigan, California, New Jersey, Texas.
43	Manganese ore	Montana, Washington, Virginia, New Mexico	Montana, Washington, New Mexico, Nevada.
50	Manganiferous ore	Minnesota, New Mexico, Nevada, Utah	Minnesota, New Mexico, Utah, Nevada.
65	Manganiferous zinc residuum	New Jersey	Rank same as for quantity.

See footnotes at end of table.

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Mineral products of the United States and principal producing States in 1946—Continued

Rank in value	Product	Principal producing States [1]	
		In order of quantity	In order of value
	Marl:		
82	Calcareous	Virginia, Indiana, West Virginia, Michigan	Virginia, West Virginia, Indiana, Nevada.
74	Greensand	New Jersey	Rank same as for quantity.
52	Mercury	California, Nevada, Oregon, Idaho	Do.
57	Mica	North Carolina, California, Colorado, South Dakota	North Carolina, South Dakota, New Hampshire, Colorado.
	Scrap	do	North Carolina, South Dakota, Colorado, Georgia.
	Sheet	North Carolina, New Hampshire, Connecticut, South Dakota	Rank same as for quantity.
95	Millstones		New York, North Carolina, Virginia.
	Mineral pigments:		
29	Natural pigments and manufactured iron oxide pigments.	Pennsylvania, Illinois, Virginia, New Jersey	Pennsylvania, Illinois, New Jersey, Virginia.
23	Lead and zinc pigments	Pennsylvania, Illinois, Kansas, Ohio	Rank same as for quantity.
(4)	Mineral waters	No canvass for 1946	No canvass for 1946.
28	Molybdenum	Colorado, Utah, New Mexico, Arizona	Rank same as for quantity.
4	Natural gas	Texas, Louisiana, California, Oklahoma	Texas, California, Louisiana, West Virginia.
9	Natural gasoline and allied products:		
	Natural gasoline and cycle products	Texas, California, Louisiana, Oklahoma	Rank same as for quantity.
	Liquefied petroleum gases	Texas, California, Oklahoma, Louisiana	Texas, California, Louisiana, Illinois.
76	Nickel	Not separable by States	Not separable by States.
78	Oilstones, etc	Arkansas, Ohio, Indiana, New Hampshire	Arkansas, Ohio, New Hampshire, Indiana.
87	Olivine	North Carolina, Washington	Rank same as for quantity.
(4)	Ores (crude), etc.:		
	Copper	Arizona, Utah, New Mexico, Nevada	Value not available.
	Dry and siliceous (gold and silver)	South Dakota, Colorado, California, Nevada	Do.
	Lead	Missouri, Idaho, California, Illinois	Do.
	Lead-copper	Missouri, Utah, Arizona, Idaho	Do.
	Zinc	Oklahoma, Kansas, Tennessee, Missouri	Do.
	Zinc-copper	Washington, California, Arizona	Do.
	Zinc-lead	Oklahoma, Idaho, Kansas, Missouri	Do.
	Zinc-lead-copper	Arizona	Do.
59	Peat	Maine, New Jersey, Florida, Ohio	Ohio, New Jersey, Michigan, California.
85	Pebbles for grinding	Minnesota, Wisconsin, North Carolina, Texas	North Carolina, Minnesota, Wisconsin, Texas.
92	Perlite	Arizona, Maryland, California	Rank same as for quantity.
1	Petroleum	Texas, California, Louisiana, Oklahoma	Do.
25	Phosphate rock	Florida, Tennessee, Idaho, Montana	Do.
55	Platinum metals	Alaska, California	Do.
24	Potassium salts	New Mexico, California, Utah, Maryland	Do.
56	Pumice	Idaho, California, New Mexico, Kansas	California, New Mexico, Idaho, Kansas.
49	Pyrites	Tennessee, Virginia, California, Montana	Tennessee, California, Virginia, New York.
22	Salt	Michigan, New York, Ohio, Louisiana	Michigan, New York, Louisiana, Ohio.
13	Sand and gravel	California, Illinois, Michigan, Wisconsin	California, Illinois, Ohio, Pennsylvania.
64	Selenium	Not separable by States	Not separable by States.

80	Silica (quartz)	Washington, North Carolina, California, Wisconsin	North Carolina, California, Washington, Oregon.
46	Silica sand and sandstone (ground)	Illinois, New Jersey, Pennsylvania, Ohio	Illinois, Ohio, New Jersey, Pennsylvania.
26	Silver	Idaho, Utah, Montana, Arizona	Rank same as for quantity.
32	Slate		Pennsylvania, Vermont, New York, Georgia.
41	Sodium salts (carbonates and sulfates) (natural)	California, Texas, Wyoming	Rank same as for quantity.
7	Stone	Pennsylvania, Ohio, Illinois, Michigan	Pennsylvania, Ohio, Illinois, New York.
99	Strontium minerals	California	Rank same as for quantity.
17	Sulfur	Texas, Louisiana	Do.
35	Sulfuric acid from copper, lead, and zinc smelters and zinc roasters.	Pennsylvania, Illinois, Tennessee, Indiana	Do.
86	Sulfur ore	Texas, California, Colorado, Nevada	Do.
37	Talc, pyrophyllite, and ground soapstone [5]	New York, North Carolina, California, Vermont	New York, California, North Carolina, Vermont.
98	Tantalum and columbium concentrates	New Mexico, South Dakota	Rank same as for quantity.
89	Tellurium	Not separable by States	Not separable by States.
97	Thallium	do	Do.
	Titanium concentrates:		
42	Ilmenite	New York, Florida, Virginia, North Carolina	New York, Florida, North Carolina, Virginia.
60	Rutile	Florida, Virginia	Rank same as for quantity.
96	Topaz (industrial)	South Carolina	Do.
70	Tripoli	Illinois, Missouri, Pennsylvania	Do.
39	Tungsten concentrates	Nevada, California, Idaho, North Carolina	Do.
66	Vanadium	Colorado, Idaho, Utah, Arizona	Do.
61	Vermiculite	Montana, Wyoming, South Carolina, Texas	Montana, South Carolina, Wyoming, Texas.
100	Wollastonite	New York	Rank same as for quantity.
16	Zinc	Idaho, Oklahoma, New Jersey, Kansas	Do.
69	Zircon	Florida	Do.

[1] Rank of States in metal production (except aluminum, ferro-alloys, and pig iron) arranged according to mine reports, not smelter output.
[2] Separate figures for antimonial lead from primary sources not available.
[3] No canvass for 1946. [4] Value not available. [5] Exclusive of soapstone used as dimension stone (all from Virginia), which is included in figures for stone.

States and their principal mineral products in 1945 [1]

State	Rank	Percent of total value for United States	Principal mineral products in order of value
Alabama	15	1.60	Coal, iron ore, cement, stone.
Alaska	37	.15	Sand and gravel, gold, coal, stone.
Arizona	16	1.43	Copper, zinc, lead, gold.
Arkansas	24	.92	Petroleum, coal, natural gas, bauxite.
California	3	9.00	Petroleum, natural gas, natural gasoline, cement.
Colorado	21	1.12	Coal, molybdenum, zinc, petroleum.
Connecticut	45	.05	Stone, clay products, sand and gravel, magnesium.
Delaware	50	(2)	Clay products, sand and gravel.
District of Columbia	49	(2)	Clay products, raw clay.
Florida	31	.36	Phosphate rock, stone, cement, sand and gravel.
Georgia	34	.29	Raw clay, stone, clay products, fuller's earth.
Idaho	26	.64	Zinc, lead, silver, tungsten concentrates.
Illinois	5	4.81	Coal, petroleum, stone, sand and gravel.
Indiana	18	1.30	Coal, cement, petroleum, stone.
Iowa	30	.36	Coal, cement, stone, clay products.
Kansas	9	3.02	Petroleum, natural gas, zinc, coal.
Kentucky	8	3.99	Coal, natural gas, petroleum, stone.
Louisiana	7	4.26	Petroleum, natural gas, natural gasoline, sulfur.
Maine	46	.04	Sand and gravel, cement, stone, slate.
Maryland	35	.22	Coal, sand and gravel, cement, stone.
Massachusetts	41	.08	Stone, sand and gravel, lime, clay products.
Michigan	12	2.03	Iron ore, petroleum, salt, natural gas.
Minnesota	11	2.42	Iron ore, manganiferous ore, sand and gravel, stone.
Mississippi	32	.32	Petroleum, natural gas, sand and gravel, clay products.
Missouri	23	1.08	Lead, coal, cement, stone.
Montana	22	1.10	Copper, petroleum, natural gas, coal.
Nebraska	43	.07	Sand and gravel, cement, stone, petroleum.
Nevada	27	.45	Copper, zinc, gold, tungsten concentrates.
New Hampshire	47	.01	Feldspar, sand and gravel, mica, stone.
New Jersey	29	.45	Zinc, sand and gravel, stone, iron ore.
New Mexico	14	1.72	Petroleum, potassium salts, natural gas, copper.
New York	17	1.33	Petroleum, iron ore, salt, cement.
North Carolina	36	.21	Clay products, bromine, stone, sand and gravel.
North Dakota	44	.07	Coal, sand and gravel, natural gas, clay products.
Ohio	10	2.85	Coal, natural gas, clay products, stone.
Oklahoma	6	4.29	Petroleum, natural gas, natural gasoline, zinc.
Oregon	38	.14	Sand and gravel, cement, stone, clay products.
Pennsylvania	2	13.55	Coal, petroleum, natural gas, cement.
Rhode Island	48	.01	Stone, sand and gravel, graphite.
South Carolina	42	.07	Stone, raw clay, clay products, sand and gravel.
South Dakota	40	.10	Gold, stone, raw clay, sand and gravel.
Tennessee	25	.85	Coal, zinc, stone, phosphate rock.
Texas	1	19.68	Petroleum, natural gas, natural gasoline, sulfur.
Utah	13	1.87	Copper, coal, gold, zinc.
Vermont	39	.12	Stone, slate, talc, copper.
Virginia	19	1.19	Coal, stone, zinc, cement.
Washington	28	.45	Coal, cement, sand and gravel, stone.
West Virginia	4	8.44	Coal, natural gas, petroleum, natural gasoline.
Wisconsin	33	.32	Stone, sand and gravel, zinc, iron ore.
Wyoming	20	1.17	Petroleum, coal, natural gas, natural gasoline.

[1] In this table iron ore, not pig iron, is taken as the basis of iron valuation, and for other metals mine production (recoverable content of metals) is the basis.
[2] Less than 0.01 percent.

States and their principal mineral products in 1946 [1]

State	Rank	Percent of total value for United States	Principal mineral products in order of value
Alabama	15	1.52	Coal, iron ore, cement, clay products.
Alaska	38	.16	Gold, coal, platinum metals, sand and gravel.
Arizona	14	1.53	Copper, zinc, lead, gold.
Arkansas	24	.90	Petroleum, coal, bauxite, natural gas.
California	3	9.03	Petroleum, natural gas, natural gasoline, cement.
Colorado	22	1.01	Coal, petroleum, zinc, molybdenum.
Connecticut	45	.07	Clay products, stone, sand and gravel, lime.
Delaware	50	.01	Clay products, sand and gravel, stone.

See footnote at end of table.

States and their principal mineral products in 1946—Continued

State	Rank	Percent of total value for United States	Principal mineral products in order of value
District of Columbia	48	.01	Clay products, raw clay.
Florida	32	.40	Phosphate rock, stone, cement, sand and gravel.
Georgia	33	.39	Raw clay, stone, clay products, cement.
Idaho	26	.58	Zinc, lead, silver, phosphate rock.
Illinois	5	4.61	Coal, petroleum, stone, clay products.
Indiana	17	1.40	Coal, cement, petroleum, stone.
Iowa	29	.45	Cement, clay products, stone, coal.
Kansas	10	3.15	Petroleum, natural gas, zinc, cement.
Kentucky	8	3.74	Coal, natural gas, petroleum, stone.
Louisiana	6	4.44	Petroleum, natural gas, natural gasoline, sulfur.
Maine	46	.06	Cement, stone, sand and gravel, slate.
Maryland	35	.28	Coal, sand and gravel, cement, stone.
Massachusetts	41	.13	Stone, sand and gravel, clay products, lime.
Michigan	12	1.90	Iron ore, petroleum, cement, salt.
Minnesota	11	2.02	Iron ore, stone, sand and gravel, manganiferous ore.
Mississippi	28	.46	Petroleum, natural gas, sand and gravel, clay products.
Missouri	20	1.13	Lead, cement, coal, stone.
Montana	25	.89	Copper, petroleum, natural gas, coal.
Nebraska	43	.09	Cement, sand and gravel, clay products, stone.
Nevada	27	.46	Copper, zinc, tungsten concentrates, gold.
New Hampshire	47	.02	Sand and gravel, feldspar, stone, clay products.
New Jersey	30	.43	Zinc, sand and gravel, stone, clay products.
New Mexico	13	1.67	Petroleum, potassium salts, natural gas, copper.
New York	16	1.40	Petroleum, cement, stone, salt.
North Carolina	36	.26	Stone, clay products, sand and gravel, feldspar.
North Dakota	44	.07	Coal, sand and gravel, natural gas, clay products.
Ohio	9	3.16	Coal, clay products, natural gas, stone.
Oklahoma	7	4.22	Petroleum, natural gas, zinc, natural gasoline.
Oregon	40	.15	Sand and gravel, cement, stone, clay products.
Pennsylvania	2	14.13	Coal, petroleum, cement, natural gas.
Rhode Island	49	.01	Stone, sand and gravel, graphite.
South Carolina	42	.11	Stone, raw clay, clay products, sand and gravel.
South Dakota	37	.24	Gold, stone, cement, sand and gravel.
Tennessee	23	.91	Coal, cement, stone, phosphate rock.
Texas	1	19.67	Petroleum, natural gas, natural gasoline, sulfur.
Utah	18	1.25	Copper, coal, zinc, lead.
Vermont	39	.16	Stone, slate, copper, talc.
Virginia	19	1.19	Coal, stone, sand and gravel, zinc.
Washington	31	.43	Cement, coal, sand and gravel, stone.
West Virginia	4	8.20	Coal, natural gas, petroleum, stone.
Wisconsin	34	.37	Stone, sand and gravel, iron ore, zinc.
Wyoming	21	1.13	Petroleum, coal, natural gas, natural gasoline.

[1] In this table iron ore, not pig iron, is taken as the basis of iron valuation and for other metals mine production (recoverable content of metals) is the basis.

Prices of gold, silver, copper, lead, and zinc, 1937–46 [1]

Year	Gold [2]	Silver [3]	Copper [4]	Lead [4]	Zinc [4]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1937	$35.00	$0.7735	$0.121	$0.059	$0.065
1938	35.00	[5] .646+	.098	.046	.048
1939	35.00	[6] .678+	.104	.047	.052
1940	35.00	[7] .711+	.113	.050	.063
1941	35.00	[7] .711+	.118	.057	.075
1942	35.00	[7] .711+	.121	.067	.093
1943	35.00	[7] .711+	.130	.075	.108
1944	35.00	[7] .711+	.135	.080	.114
1945	35.00	[7] .711+	.135	.086	.115
1946	35.00	[8] .808	.162	.109	.122

[1] For data on prices prior to 1937, see Minerals Yearbook, 1945, p. 40.
[2] Price under authority of Gold Reserve Act of Jan. 31, 1934.
[3] 1937: Yearly average weighted Treasury buying price for newly mined silver. 1938–46: Treasury buying price for newly mined silver.
[4] Yearly average weighted price of all grades of primary metal sold by producers. Beginning 1942, price includes premiums paid to miners by the Government.
[5] $0.64646464.
[6] $0.67878787.
[7] $0.71111111.
[8] Jan. 1 to June 30, 1946: $0.71111111; July 1 to Dec. 31, 1946: $0.905.

STATE TABLES

Mineral products of the United States, 1944–46, by States

ALABAMA

Product		1944		1945		1946	
		Quantity	Value	Quantity	Value	Quantity	Value
Aluminum	short tons	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)
Asphalt (native)	do	(1)	(1)	(1)	(1)	(1)	(1)
Bauxite (dried equivalent)	long tons	(1)	(1)	(1)	(1)	(1)	(1)
Cement	barrels	[3] 4,553,664	[3] $6,777,741	[3] 5,682,692	[3] $8,359,286	[3] 8,071,979	[3] $13,120,084
Clay:							
Products, heavy clay (other than pottery and refractories)			[4] 1,970,000		[4] 2,515,068		[4] 4,419,000
Raw	short tons	[5] 155,717	[5] 230,186	[5] 735,504	[5] 715,274	[5] 1,064,000	[5] 1,073,052
Coal	do	18,752,165	74,389,893	18,236,539	76,404,636	15,780,000	72,588,000
Coke	do	5,727,612	[2] 32,057,495	5,400,925	[2] 33,448,229	4,665,939	[2] 32,669,886
Ferro-alloys	do	128,729	[2] 11,609,967	145,377	[2] 14,636,471	137,042	[2] 14,510,937
Gold	troy ounces			5	175	1	35
Graphite, crystalline	pounds	(1)	(1)	(1)	(1)	(1)	(1)
Iron:							
Ore	long tons	6,808,111	17,684,154	6,038,631	14,547,223	5,993,800	17,458,295
Pig	short tons	3,936,471	[2] 68,239,438	3,588,863	[2] 65,991,229	3,145,303	[2] 66,517,978
Lime	do	333,414	2,004,391	315,559	2,076,768	294,654	2,164,209
Manganese ore	do	49	(1)	32	(1)		
Mica:							
Scrap	do	63	1,036			338	6,621
Sheet	pounds	1,387	7,173	420	1,629	289	74
Mineral waters	gallons sold	(6)	(6)	(6)	(6)	(6)	(6)
Ore (dry and siliceous) (gold and silver)	short tons			400	(7)		
Petroleum	barrels	43,000	(1)	181,000	(1)	380,000	(1)
Quartz crystal	pounds	(8)	(8)				
Sand and gravel	short tons	2,019,272	1,172,969	2,541,769	1,580,687	2,923,240	1,937,576
Silver	troy ounces			1	1		
Stone	short tons	2,542,210	3,385,801	2,238,740	3,326,753	1,874,330	3,385,892
Miscellaneous [9]			16,573,667		12,223,870		10,819,325
Total value, eliminating duplications			109,149,000		110,360,000		117,764,000

[1] Value included with "Miscellaneous."
[2] Value not included in total value for State.
[3] Exclusive of puzzolan, value for which is included with "Miscellaneous."
[4] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[5] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included with the metals.
[8] Figure not available.
[9] Includes minerals indicated by "1" and "3" above.

ALASKA

Antimony ore (concentrates)	short tons	73	$6,465				
Arsenic	do	(1)	(1)	(1)	(1)	(1)	(1)
Asbestos	do	(2)	(2)				
Chromite	do	1,845	64,456				
Coal	do	348,375	2,239,684	297,644	$1,868,592	368,000	$2,359,000
Copper	pounds	4,000	540	10,000	1,350	4,000	648
Gem stones					(3)		(3)
Gold	troy ounces	49,296	1,725,360	68,117	2,384,095	226,781	7,937,335
Lead	short tons	44	7,040	11	1,892	115	25,070
Mercury	flasks (76 pounds)	(2)	(2)	(2)	(2)	699	68,670
Ores (crude), etc.:							
Copper	short tons			6	(4)		
Dry and siliceous (gold and silver)	do	381,574	(4)	6,506	(4)	8,979	(4)
Lead	do					1,819	(4)
Platinum metals (crude)	troy ounces	33,616	(2)	26,505	(2)	22,882	(2)
Sand and gravel	short tons	712,496	499,269	(2)	(2)	(2)	(2)
Silver	troy ounces	13,362	9,502	9,983	7,099	41,793	33,769
Stone	short tons	(2)	(2)	(2)	(2)	(2)	(2)
Tungsten concentrates (60-percent WO_3 basis)	do	19	(2)			19	(2)
Miscellaneous [5]			2,350,309		5,910,704		2,005,241
Total value, eliminating duplications			6,903,000		10,174,000		12,430,000

[1] Figure not available.
[2] Value included with "Miscellaneous."
[3] No canvass.
[4] Not valued as ore; value of recoverable metal content included with the metals.
[5] Includes minerals indicated by "2" above.

ARIZONA

Arsenious oxide	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Asbestos	do	696	$158,272	1,273	$63,736	(2)	(2)
Barite	do					(2)	(2)
Bismuth	pounds	(1)	(1)	(1)	(1)	(1)	(1)
Clay:							
Products, heavy clay (other than pottery and refractories)			(2 3)		(2 3)		[3] $479,000
Raw	short tons	(2 4)	(2 4)	[4] 124,166	[4] 204,680	[4] 168,081	[4] 230,703
Coal	do	6,081	17,216	3,853	13,487	8,000	30,000
Copper	pounds	716,606,000	96,741,810	574,406,000	77,544,810	578,446,000	93,708,252
Diatomite	short tons			(2)	(2)	(2)	(2)
Feldspar (crude)	long tons	(2)	(2)	(2)	(2)	(2)	(2)
Fluorspar	short tons	976	21,983	1,126	21,016	389	7,959
Gem stones			(5)		(5)		[5]
Gold	troy ounces	112,162	3,925,670	77,223	2,702,805	79,024	2,765,840
Gypsum (crude)	short tons			(2)	(2)	(2)	(2)
Lead	do	16,707	2,673,120	22,867	3,933,124	23,930	5,216,740
Lime	do	61,091	527,792	58,736	522,609	50,354	489,091

See footnotes at end of table.

Mineral products of the United States, 1944–46, by States—Continued

ARIZONA—Continued

Product	1944		1945		1946	
	Quantity	Value	Quantity	Value	Quantity	Value
Manganese ore—short tons	8,519	$223,926	1,093	$45,521		
Manganiferous ore—do	320	6,941	56	(2)		
Mercury—flasks (76 pounds)	548	64,861	(2)	(2)	95	$9,333
Mica:						
Scrap—short tons			(2)	(2)		
Sheet—pounds	(2)	(2)	(2)	(2)		
Molybdenum—do	856,565	624,336	635,572	472,760	(2)	(2)
Ores (crude), etc.:						
Copper—short tons	35,288,865	(6)	30,644,470	(6)	30,386,149	(6)
Dry and siliceous (gold and silver)—do	129,086	(6)	19,506	(6)	53,094	(6)
Lead—do	27,101	(6)	21,340	(6)	13,441	(6)
Lead-copper—do			2	(6)	1,066	(6)
Zinc—do	2,468	(6)	8,914	(6)	13,233	(6)
Zinc-copper—do	96,603	(6)	81,123	(6)	63,854	(6)
Zinc-lead—do	337,940	(6)	480,061	(6)	515,047	(6)
Zinc-lead-copper—do	18,578	(6)	11,488	(6)	12,295	(6)
Perlite—do					1,725	9,488
Quartz crystal—pounds	(1)	(1)				
Sand and gravel—short tons	586,164	342,038	528,059	442,959	1,098,791	974,347
Sand and sandstone (ground)—do			(2)	(2)		
Silica (quartz)—do	(2)	(2)	(2)	(2)	(2)	(2)
Silver—troy ounces	4,394,039	3,124,650	3,558,216	2,530,287	3,268,765	2,641,162
Stone—short tons	7 116,670	7 105,662	404,170	376,200	7 191,430	7 269,279
Sulfuric acid (60° B.) [8]—do	(2 9)	(2 9)	(2 9)	(2 9)	(2 9)	(2 9)
Tungsten concentrates (60-percent WO_3 basis)—do	29	42,763	97	(2)	20	27,080
Vanadium—pounds	13,382	10,883	(2)	(2)	(2)	(2)
Zinc—short tons	29,077	6,629,556	40,226	9,251,980	43,665	10,654,260
Miscellaneous [10]		791,934		707,383		633,805
Total value, eliminating duplications		115,592,000		98,574,000		118,055,000

[1] Figure not available.
[2] Value included with "Miscellaneous."
[3] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[4] 1944: sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included with the metals.
[7] Exclusive of granite and sandstone, values for which are included with "Miscellaneous."
[8] From copper smelting.
[9] Value not included in total value for State.
[10] Includes minerals indicated by "2" and "7" above.

Aluminum	short tons	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)
Barite	do	159,686	$1,045,546	260,660	$1,934,098	288,286	$1,844,982
Bauxite (dried equivalent)	long tons	2,695,317	13,679,027	910,049	5,196,927	1,019,118	6,394,570
Cement	barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:							
Products, heavy clay (other than pottery and refractories)			3 530,000		3 794,498		3 1,276,000
Raw	short tons	4 32,727	4 33,177	4 279,397	4 427,038	4 388,606	4 712,906
Coal	do	1,972,441	9,220,773	1,853,926	9,365,577	1,540,000	9,024,000
Gem stones			(5)		(5)		(5)
Gypsum (crude)	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Iron ore	long tons	76	(1)				
Lead	short tons			1	172	2	436
Lime	do	(1)	(1)	(1)	(1)	(1)	(1)
Manganese ore	do	7,109	241,055	6,663	228,476	1,101	28,237
Manganiferous ore	do	14,755	134,473	14,806	(1)	1,964	(1)
Mercury	flasks (76 pounds)	191	22,607	(1)	(1)	11	1,081
Mineral waters	gallons sold	(5)	(5)	(5)	(5)	(5)	(5)
Natural gas	M cubic feet	46,453,000	5,824,000	46,600,000	6,145,000	43,000,000	6,020,000
Natural gasoline and allied products:							
Natural gasoline	gallons	43,701,000	2,190,000	53,832,000	2,585,000	50,198,000	2,021,000
Liquefied petroleum gases	do	31,835,000	800,000	32,109,000	833,000	33,882,000	881,000
Oilstones and whetstones	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Ores (crude), etc.:							
Lead	do					2	(6)
Zinc	do	800	(6)	14,891	(6)	4,300	(6)
Petroleum	barrels	29,418,000	30,890,000	28,613,000	30,720,000	28,375,000	35,400,000
Quartz crystal	pounds	(7)	(7)				
Sand and gravel	short tons	2,665,688	1,805,699	2,688,622	1,930,780	8 2,203,647	8 1,821,423
Slate			6,102		50,000		(1)
Stone	short tons	730,310	790,271	9 932,320	9 926,763	995,720	1,135,856
Titanium concentrates: Rutile	do	(1)	(1)				
Tripoli	do	(1)	(1)				
Zinc	do	19	4,332	303	69,690	85	20,740
Miscellaneous 10			20,570,751		13,405,590		9,794,737
Total value, eliminating duplications			68,681,000		63,256,000		69,881,000

1 Value included with "Miscellaneous."
2 Value not included in total value for State.
3 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
4 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
5 No canvass.
6 Not valued as ore; value of recoverable metal content included with the metals.
7 Figure not available.
8 "Commercial." Value of "Government-and-contractor" included with "Miscellaneous."
9 Exclusive of sandstone, value for which is included with "Miscellaneous."
10 Includes minerals indicated by "1," "8," and "9" above.

Mineral products of the United States, 1944–46, by States—Continued

CALIFORNIA

Product	1944		1945		1946	
	Quantity	Value	Quantity	Value	Quantity	Value
Aluminum short tons	(1 2)	(1 2)				
Andalusite do	(1)	(1)	(1)	(1)		
Antimony ore (concentrates) do	14	$872				
Arsenious oxide do	(3)	(3)	(3)	(3)	(3)	(3)
Asbestos do	(1)	(1)	31	$2,597	(1)	(1)
Asphalt (native) do	(1)	(1)	(1)	(1)	(1)	(1)
Barite do	(1)	(1)	(1)	(1)	(1)	(1)
Boron minerals do	277,586	6,579,587	325,935	7,635,365	430,689	$9,575,866
Bromine pounds	(1)	(1)	(1)	(1)	(1)	(1)
Calcite (Iceland spar) do	(1)	(1)			(4)	(4)
Calcium chloride short tons	7,715	119,747	7,165	126,377	9,979	170,994
Cement barrels	14,977,023	22,645,600	15,921,965	23,517,146	20,173,231	33,906,675
Chromite short tons	34,715	1,268,790	9,607	364,715	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)		5 4,500,000		5 5,728,220		5 12,175,000
Raw short tons	6 578,236	6 1,454,813	6 1,212,372	6 2,111,918	6 1,670,305	6 2,254,164
Coke do	339,570	(1 2)	256,092	(1 2)	260,470	(1 2)
Copper pounds	25,442,000	3,434,670	12,946,000	1,747,710	8,480,000	1,373,760
Diatomite short tons	(1)	(1)	(1)	(1)	(1)	(1)
Feldspar (crude) long tons	(1)	(1)	(1)	(1)		
Ferro-alloys short tons	(1 2)	(1 2)	5,382	(1 2)	7,414	(1 2)
Fluorspar do	26	650				
Fuller's earth do	(1)	(1)	(1)	(1)	(1)	(1)
Gem stones		(4)		(4)		(4)
Gold troy ounces	117,373	4,108,055	147,938	5,177,830	356,824	12,488,840
Gypsum (crude) short tons	502,629	799,882	455,319	967,507	574,345	1,315,699
Iodine pounds	(1)	(1)	(1)	(1)	(1)	(1)
Iron:						
Ore long tons	634,264	1,844,948	326,295	1,050,338	226,062	(1)
Pig short tons	384,528	(1 2)	313,883	(1 2)	344,024	(1 2)
Kyanite do					(1)	(1)
Lead do	5,682	909,120	7,224	1,242,528	9,923	2,163,214
Lime do	130,763	1,441,604	135,158	1,515,497	172,623	2,144,712
Lithium minerals do	(1)	(1)	(1)	(1)	(1)	(1)
Magnesite do	(1)	(1)	(1)	(1)	(1)	(1)
Magnesium do	(1)	(1)	(1)	(1)		
Magnesium compounds (natural) pounds	140,578,000	3,218,192	109,146,000	2,642,666	56	21,664
Manganese ore short tons	21,540	712,856	1,668	78,598	111,906,000	2,814,979
Manganiferous ore do	4,598	44,015	12	(1)		
Mercury flasks (76 pounds)	28,052	3,320,235	21,199	2,859,533	17,782	1,746,904
Mica, scrap short tons			3,582	5,373	(1)	(1)
Mineral waters gallons sold	(4)	(4)	(4)	(4)	(4)	(4)

Molybdenum	pounds	(1)	(1)	(1)	(1)	(1)	(1)
Natural gas	M cubic feet	502,017,000	133,484,000	502,442,000	136,241,000	490,000,000	134,750,000
Natural gasoline and allied products:							
Natural gasoline and cycle products	gallons	632,768,000	28,530,000	731,422,000	29,473,000	732,079,000	31,774,000
Liquefied petroleum gases	do	138,512,000	4,445,000	160,331,000	5,259,000	178,390,000	4,995,000
Ores (crude), etc.:							
Copper	short tons	556,378	(7)	311,326	(7)	86,297	(7)
Dry and siliceous (gold and silver)	do	135,597	(7)	173,225	(7)	335,657	(7)
Lead	do	39,081	(7)	26,053	(7)	57,330	(7)
Zinc	do	69,204	(7)	60,105	(7)	45,043	(7)
Zinc-copper	do	90,059	(7)	112,861	(7)	99,176	(7)
Zinc-lead	do	35,634	(7)	34,399	(7)	4,264	(7)
Peat	do	5,849	96,141	6,185	85,877	8,137	105,242
Pebbles for grinding	do	(1)	(1)	(1)	(1)	74	927
Perlite	do					886	4,873
Petroleum	barrels	311,793,000	330,800,000	326,482,000	347,330,000	315,179,000	393,300,000
Platinum metals (crude)	troy ounces			43	(1)	67	(1)
Potassium salts	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Pumice	do	31,409	245,898	75,238	481,664	89,181	755,570
Pyrites	long tons	(1)	(1)	(1)	(1)	(1)	(1)
Quartz crystal	pounds	(3)	(3)				
Salt (sodium chloride)	short tons	712,558	3,138,185	694,609	3,424,711	729,092	3,358,060
Sand and gravel	do	24,228,499	15,171,652	21,599,950	15,176,259	27,220,849	18,396,460
Sand and sandstone (ground)	do	(1)	(1)	(1)	(1)	(1)	(1)
Silica (quartz)	do	(1)	(1)	(1)	(1)	(1)	(1)
Silver	troy ounces	778,936	553,910	986,798	701,723	1,342,651	1,084,862
Slate			80,959		(2)		(1)
Sodium salts (carbonates and sulfates) (natural)	short tons	288,012	3,566,183	(1)	(2)	(1)	(1)
Stone	do	[8] 9,909,680	[8] 9,987,362	9,636,810	8,554,461	[8] 8,950,320	[8] 8,452,083
Strontium minerals	do	(1)	(1)	(1)	(1)	243	3,726
Sulfuric acid (60° B.)[9]	do	(1 2)	(1 2)	(1 2)	(3 2)	(1 2)	(1 2)
Sulfur ore	long tons					757	11,835
Talc, pyrophyllite, and ground soapstone	short tons	65,191	1,054,312	67,321	1,254,143	78,170	1,434,978
Tin (metallic equivalent)	do	2	1,970				
Tungsten concentrates (60-percent WO_3 basis)	do	3,027	4,558,545	1,073	1,488,289	1,262	1,117,855
Zinc	do	8,455	1,927,740	9,923	2,282,290	6,877	1,677,968
Miscellaneous [10]			43,704,640		23,312,132		25,336,529
Total value, eliminating duplications			607,370,000		621,308,000		696,997,000

[1] Value included with "Miscellaneous."
[2] Value not included in total value for State.
[3] Figure not available.
[4] No canvass.
[5] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[6] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[7] Not valued as ore; value of recoverable metal content included with the metals.
[8] Exclusive of marble, value for which is included with "Miscellaneous."
[9] From lead smelting.
[10] Includes minerals indicated by "1" and "3" above.

Mineral products of the United States, 1944–46, by States—Continued

COLORADO

Product	1944		1945		1946	
	Quantity	Value	Quantity	Value	Quantity	Value
Arsenious oxide short tons	(1)	(1)	(1)	(1)	(1)	(1)
Beryllium concentrates do	35	$5,125				
Bismuth pounds	(1)	(1)	(1)	(1)	(1)	(1)
Cement barrels	(2)	(2)	(2)	(2)	(2)	(2)
Clay:						
Products, heavy clay (other than pottery and refractories)		[3] 600,000		[3] $782,003		[3] $2,192,000
Raw short tons	[4] 77,710	[4] 152,569	[4] 161,266	[4] 216,348	[4] 301,107	[4] 367,686
Coal do	8,167,713	29,261,076	7,621,012	28,084,634	5,915,000	22,619,000
Coke do	732,195	(3 5)	711,777	(3 5)	617,306	(3 5)
Copper pounds	2,096,000	282,960	2,970,000	400,950	3,508,000	568,296
Feldspar (crude) long tons	15,787	81,967	26,279	105,021	37,312	145,975
Fluorspar short tons	65,209	1,604,043	52,437	1,333,735	32,539	925,867
Gem stones		(6)		(6)		(6)
Gold troy ounces	111,455	3,900,925	100,935	3,532,725	142,613	4,991,455
Gypsum (crude) short tons	(2)	(2)	(2)	(2)	(2)	(2)
Iron:						
Ore long tons			117	(2)	340	(2)
Pig short tons	747,270	(2 5)	(2 5)	(2 5)	(2 5)	(2 5)
Lead do	17,698	2,831,680	17,044	2,931,568	17,036	3,713,848
Lime do	(2)	(2)	(2)	(2)	(2)	(2)
Lithium minerals do	200	8,000	(2)	(2)	(2)	(2)
Manganiferous ore do			47	(2)		
Mica:						
Scrap do	7,640	40,846	2,999	25,044	4,495	36,910
Sheet pounds	(2)	(2)			272	93
Mineral waters gallons sold	(6)	(6)	(6)	(6)	(6)	(6)
Molybdenum pounds	(2)	(2)	(2)	(2)	(2)	(2)
Natural gas M cubic feet	5,141,000	1,311,000	4,914,000	1,334,000	7,000,000	1,680,000
Natural gasoline gallons	310,000	18,000	351,000	21,000	360,000	22,000
Ores (crude), etc.:						
Copper short tons	7,880	(7)	7,230	(7)	8,292	(7)
Dry and siliceous (gold and silver) do	640,864	(7)	627,523	(7)	841,733	(7)
Lead do	11,123	(7)	7,229	(7)	19,307	(7)
Lead-copper do					5	(7)
Zinc do	5,939	(7)	151,998	(7)	172,320	(7)
Zinc-copper do			1,090	(7)		
Zinc-lead do	884,616	(7)	561,782	(7)	421,839	(7)
Zinc-lead-copper do			699	(7)		
Peat do			(2)	(2)	(2)	(2)
Petroleum barrels	3,083,000	3,530,000	5,036,000	5,780,000	12,016,000	16,360,000
Pumice short tons					600	1,200
Pyrites long tons	(2)	(2)	(2)	(2)		

Quartz crystal	pounds	(1)	(1)				
Sand and gravel	short tons	2, 369, 521	1, 518, 718	1, 800, 405	1, 147, 027	2, 532, 946	1, 796, 395
Silver	troy ounces	2, 248, 830	1, 599, 168	2, 226, 780	1, 583, 488	2, 240, 151	1, 810, 042
Stone	short tons	680, 620	568, 095	671, 620	923, 797	612, 000	818, 606
Sulfur ore	long tons	89	1, 200	126	5, 670	(2)	(2)
Tungsten concentrates (60-percent WO_3 basis)	short tons	296	433, 303	234	222, 428	213	288, 717
Vanadium	pounds	3, 058, 727	1, 288, 326	2, 701, 103	1, 609, 884	1, 036, 050	584, 135
Vermiculite	short tons	1, 189	11, 890	(2)	(2)	(2)	(2)
Zinc	do	39, 955	9, 109, 740	35, 773	8, 227, 790	36, 147	8, 819, 868
Miscellaneous [8]			40, 868, 418		37, 925, 346		28, 874, 240
Total value, eliminating duplications			80, 202, 000		77, 458, 000		77, 960, 000

[1] Figure not available.
[2] Value included with "Miscellaneous."
[3] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[4] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[5] Value not included in total value for State.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included with the metals.
[8] Includes minerals indicated by "2" above.

CONNECTICUT

Beryllium concentrates	short tons	(1)	(1)				
Clay:							
Products, heavy clay (other than pottery and refractories)			[2] $700, 000		[2] $925, 933		[2] $2, 128, 000
Raw	short tons			[3] 63, 825	[3] 47, 597	[3] 199, 238	[3] 148, 053
Coke	do	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)
Feldspar (crude)	long tons	11, 390	75, 394	11, 705	74, 778	16, 555	98, 407
Lime	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Magnesium	do	3, 441	1, 458, 800	844	346, 100		
Mica:							
Scrap	do	593	13, 798	70	1, 752	(1)	(1)
Sheet	pounds	77, 076	147, 129	61, 832	10, 125	236, 919	25, 746
Mineral waters	gallons sold	(5)	(5)	(5)	(5)	(5)	(5)
Peat	short tons			3, 467	22, 085	4, 563	27, 027
Sand and gravel	do	1, 587, 268	784, 572	1, 611, 216	841, 509	2, 199, 654	1, 221, 839
Stone	do	1, 029, 790	1, 213, 543	817, 670	1, 166, 288	1, 324, 160	1, 878, 793
Miscellaneous [6]			4, 898, 030		4, 838, 510		4, 555, 008
Total value, eliminating duplications			4, 496, 000		3, 498, 000		5, 584, 000

[1] Value included with "Miscellaneous."
[2] 1944: Estimated by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[3] Sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] Value not included in total value for State.
[5] No canvass.
[6] Includes minerals indicated by "1" above.

Mineral products of the United States, 1944–46, by States—Continued

DELAWARE

Product	1944		1945		1946	
	Quantity	Value	Quantity	Value	Quantity	Value
Clay:						
Products, heavy clay (other than pottery and refractories)		[1] $120,000		[1] [2]		[1] [2]
Raw, short tons			[3] 6,040	[3] $6,040	[3] 33,942	[3] $33,088
Sand and gravel, do	88,445	47,269	82,674	43,678	187,229	123,532
Stone, do	9,970	14,958			23,070	57,662
Miscellaneous				86,897		310,000
Total value, eliminating duplications		182,000		131,000		491,000

[1] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.

[2] Value included with "Miscellaneous."

[3] Sold or used; value of clay used in cement and heavy clay products not included in total value for State.

DISTRICT OF COLUMBIA

Clay:						
Products, heavy clay (other than pottery and refractories)		[1] [2]		[1] [2]		[1] [2]
Raw, short tons			[2]	[2]	[2]	[2]
Miscellaneous		$111,000		$266,137		$774,825
Total value, eliminating duplications		111,000		229,000		710,000

[1] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.

[2] Value included with "Miscellaneous."

FLORIDA

Cement, barrels	[1]	[1]	[1]	[1]	[1]	[1]
Clay:						
Products, heavy clay (other than pottery and refractories)		[1] [2]		[1] [2]		[1] [2]
Raw, short tons	[1] [3]	[1] [3]	[3] 61,204	[3] $332,662	[3] 80,379	[3] $486,791
Fuller's earth, do	[1]	[1]	[1]	[1]	[1]	[1]
Lime, do	17,959	$185,565	18,431	211,077	[1]	[1]
Mineral waters, gallons sold	[4]	[4]	[4]	[4]	[4]	[4]
Natural gas, M cubic feet	6,000	[1]	6,000	[1]	10,000	300
Peat, short tons	[1]	[1]	15,194	66,747	19,979	81,832
Petroleum, barrels	12,000	[1]	30,000	[1]	57,000	[1]
Phosphate rock, long tons	3,752,795	13,534,947	4,238,228	16,298,474	[5] 5,005,511	21,017,174
Sand and gravel, short tons	1,335,569	1,180,299	1,314,011	1,074,055	1,534,667	1,320,819
Stone, do	2,730,020	2,600,462	[5] 2,617,180	[5] 3,024,465	[5] [6] 2,863,070	[5] [6] 3,212,135
Titanium concentrates:						
Ilmenite, do	[1]	[1]	[1]	[1]	[1]	[1]

Rutile	do	(1)	(1)	(1)	(1)	(1)	(1)
Zircon	do	(1)	(1)	(1)	(1)	(1)	(1)
Miscellaneous [7]			4,395,157		3,941,413		5,005,456
Total value, eliminating duplications			21,896,000		24,928,000		31,093,000

[1] Value included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[3] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] No canvass.
[5] Exclusive of unclassified stone, value for which is included with "Miscellaneous."
[6] Exclusive of dimension limestone value for which is included with "Miscellaneous."
[7] Includes minerals indicated by "1", "5", and "6" above.

GEORGIA

Asbestos	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Barite	do	108,851	$929,090	110,393	$1,056,035	69,274	$686,583
Bauxite (dried equivalent)	long tons	(1)	(1)	(1)	(1)	(1)	(1)
Cement	barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:							
Products, heavy clay (other than pottery and refractories)			(1 2)		(1 2)		(1 2)
Raw	short tons	[3] 704,642	[3] 5,854,021	[3] 1,256,664	[3] 7,108,321	[3] 1,641,660	[3] 10,222,165
Coal	do	24,285	92,629	42,568	163,837	35,000	161,000
Feldspar	long tons					(1)	(1)
Fuller's earth	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Gem stones			(4)		(4)		(4)
Gold	troy ounces	5	175			21	735
Iron ore	long tons	285,523	687,494	276,050	616,524	284,614	613,745
Kyanite	short tons					(1)	(1)
Lime	do	6,079	45,315	3,864	32,797	2,691	33,251
Magnesium sulfate (natural)	pounds	(1)	(1)	(1)	(1)	(1)	(1)
Manganese ore	short tons	1,135	(1)	1,056	25,387		
Manganiferous ore	do	2,232	25,762				
Mica:							
Scrap	do	5,305	107,135	616	14,780	1,092	30,248
Sheet	pounds	60,112	119,342	30,960	41,594	17,242	4,004
Mineral waters	gallons sold	(4)	(4)	(4)	(4)	(4)	(4)
Peat	short tons	(1)	(1)	(1)	(1)	3,218	51,286
Quartz crystal	pounds	(5)	(5)				
Sand and gravel	short tons	569,908	416,871	605,036	350,264	893,290	523,102
Sand and sandstone (ground)	do	3,090	19,823	7,190	27,858	4,406	25,993
Slate			(1)		(1)		(1)
Stone	short tons	1,773,150	5,037,596	[6] 1,514,710	[6] 4,799,320	2,417,340	8,538,435
Talc	do	30,425	363,342	32,433	296,163	36,410	380,477
Miscellaneous [7]			5,306,800		5,884,492		9,374,762
Total value, eliminating duplications			19,005,000		19,988,000		30,076,000

[1] Value included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[3] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] No canvass.
[5] Figure not available.
[6] Exclusive of crushed unclassified stone, value for which is included with "Miscellaneous."
[7] Includes minerals indicated by "1" and "6" above.

Mineral products of the United States, 1944–46, by States—Continued

IDAHO

Product	1944		1945		1946	
	Quantity	Value	Quantity	Value	Quantity	Value
Antimony ore (concentrates)—short tons	12,133	$532,906	14,465	$545,334	13,732	$784,489
Arsenious oxide—do	(1)	(1)	(1)	(1)	(1)	(1)
Bismuth—pounds	(1)	(1)	(1)	(1)	(1)	(1)
Cement—barrels	(2)	(2)	(2)	(2)	(2)	(2)
Clay:						
Products, heavy clay (other than pottery and refractories)		(2 3)		(2 3)		3 149,000
Raw—short tons	(2 4)	(2 4)	4 9,635	4 14,648	4 18,696	4 24,802
Copper—pounds	3,376,000	455,760	3,096,000	417,960	2,076,000	336,312
Diatomite—short tons	(2)	(2)				
Garnet, abrasive—do	(2)	(2)	(2)	(2)	(2)	(2)
Gem stones		(5)		(5)		(5)
Gold—troy ounces	25,008	875,280	17,780	622,300	42,975	1,504,125
Lead—short tons	83,530	13,364,800	68,447	11,772,884	59,987	13,077,166
Mercury—flasks (76 pounds)	(2)	(2)	627	84,576	868	85,272
Mica:						
Scrap—short tons	356	7,161	199	3,178		
Sheets—pounds	48,787	247,149	48,018	111,008		
Ores (crude), etc.:						
Copper—short tons	3,232	(6)	8,569	(6)	803	(6)
Dry and siliceous (gold and silver)—do	365,247	(6)	235,188	(6)	256,001	(6)
Lead—do	252,944	(6)	107,511	(6)	113,175	(6)
Lead-copper—do	39	(6)	67	(6)	119	(6)
Zinc—do	128,982	(6)	100,039	(6)	104,585	(6)
Zinc-lead—do	2,520,594	(6)	2,687,912	(6)	2,407,404	(6)
Phosphate rock—long tons	112,565	584,400	123,340	673,627	(2)	(2)
Pumice—short tons			(2)	(2)	108,847	163,515
Quartz crystal—pounds	(1)	(1)				
Sand and gravel—short tons	1,494,646	788,798	1,597,112	952,971	2,082,874	1,572,088
Silver—troy ounces	9,931,614	7,062,481	8,142,667	5,790,341	6,491,104	5,244,812
Stone—short tons	7 323,000	7 413,805	247,140	293,980	548,870	568,159
Tungsten concentrates (60-percent WO_3 basis)—do	4,005	(2)	2,130	(2)	641	(2)
Vanadium—pounds	(2)	(2)	(2)	(2)	(2)	(2)
Zinc—short tons	91,372	20,832,816	83,463	19,196,490	71,507	17,447,708
Miscellaneous 8		6,155,499		3,870,822		3,494,386
Total value, eliminating duplications		51,321,000		44,348,000		44,444,000

1 Figure not available.
2 Value included with "Miscellaneous."
3 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
4 1944, sold or shipped. 1945–46 sold or used; value of clay used in cement and heavy clay products not included in total value for State.
5 No canvass.
6 Not valued as ore; value of recoverable metal content included with the metals.
7 Exclusive of granite, value for which is included with "Miscellaneous."
8 Includes minerals indicated by "2" and "7" above.

Cement—barrels	3,419,815	$5,325,796	4,189,449	$7,089,118	6,675,584	$11,646,747
Clay:						
Products, heavy clay (other than pottery and refractories)		[1] 4,000,000		[1] 6,578,677		[1] 12,812,000
Raw—short tons	[2] 216,917	[2] 344,181	[2] 1,366,815	[2] 1,529,760	[2] 2,325,047	[2] 2,248,471
Coal—do	76,791,449	171,382,887	73,011,192	170,782,671	62,554,000	160,764,000
Coke—do	3,878,764	[3] 34,074,422	3,681,516	[3] 32,377,629	3,192,395	[3] 32,241,972
Fluorspar—do	176,259	5,954,991	147,251	5,014,807	134,525	5,493,642
Fuller's earth—do	42,277	390,346	43,664	403,084	33,134	296,637
Iron, pig—do	5,686,397	[3] 118,953,078	5,061,368	[3] 116,303,897	4,359,719	[3] 109,717,853
Lead—do	1,971	315,360	3,005	516,860	3,865	842,570
Lime—do	290,988	2,266,539	287,607	2,229,335	280,051	2,365,455
Marl, calcareous—do	14,485	10,596	10,119	7,464	7,299	7,132
Mineral paints (zinc and lead pigments)—do	[3 4]	[3 4]	[3 4]	[3 4]	[3 4]	[3 4]
Mineral waters—gallons sold	[5]	[5]	[5]	[5]	[5]	[5]
Natural gas—M cubic feet	18,137,000	2,942,000	16,663,000	2,883,000	16,100,000	2,898,000
Natural gasoline and allied products:						
Natural gasoline—gallons	61,351,000	3,870,000	55,023,000	3,560,000	53,612,000	2,895,000
Liquefied petroleum gases—do	133,018,000	4,130,000	120,969,000	4,074,000	108,334,000	3,358,000
Ores (crude), etc.:						
Lead—short tons					40,059	[6]
Zinc—do	28,137	[6]	73,312	[6]	160,032	[6]
Zinc-lead—do	136,907	[6]	203,947	[6]	192,342	[6]
Peat—do	[4]	[4]	[4]	[4]	[4]	[4]
Petroleum—barrels	77,413,000	107,370,000	75,094,000	105,130,000	75,297,000	119,420,000
Pyrites—long tons	8,259	15,262	6,861	12,680	1,740	2,871
Sand and gravel—short tons	12,317,626	8,922,068	12,613,555	8,606,155	16,771,242	11,458,969
Sand and sandstone (ground)—do	158,673	1,098,275	144,212	1,003,273	144,753	1,061,046
Silver—troy ounces	2,437	1,733	2,198	1,563	2,302	1,860
Stone—short tons	10,680,640	10,700,140	10,950,940	11,384,625	15,635,470	16,891,933
Sulfuric acid (60° B.) [7]—do	234,245	[3] 2,328,395	216,482	[3] 2,186,468	187,082	[3] 1,825,920
Tripoli—do	12,031	205,732	11,144	184,189	15,631	321,600
Zinc—do	7,262	1,655,736	8,310	1,911,300	8,798	2,146,712
Miscellaneous [8]		6,036,014		5,288,334		6,088,950
Total value, eliminating duplications		330,961,000		332,052,000		355,578,000

[1] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[2] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[3] Value not included in total value for State.
[4] Value included with "Miscellaneous."
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included with the metals.
[7] From zinc smelting.
[8] Includes minerals indicated by "4" above.

Mineral products of the United States, 1944–46, by States—Continued

INDIANA

Product	1944		1945		1946	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement—barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)		[2] $2,800,000		[2] $3,405,844		[2] $7,845,000
Raw—short tons	[3] 88,397	[3] 99,625	[3] 434,530	[3] 429,868	[3] 983,669	[3] 1,004,877
Coal—do	27,961,883	62,917,512	25,182,611	58,337,026	21,818,000	55,418,000
Coke—do	8,821,021	[4] 74,079,053	7,814,247	[4] 68,458,007	6,651,567	[4] 59,312,827
Ferro-alloys—do	([1 4])	([1 4])	([1 4])	([1 4])		
Iron, pig—do	6,857,453	[4] 153,676,643	5,981,937	[4] 138,253,310	4,823,257	[4] 122,786,881
Lime—do	(1)	(1)	(1)	(1)	(1)	(1)
Marl, calcareous—do	12,400	4,064	22,705	8,766	38,175	19,080
Mineral paints (zinc and lead pigments)—do	([1 4])	([1 4])	([1 4])	([1 4])	([1 4])	([1 4])
Mineral waters—gallons sold	([5])	([5])	([5])	([5])	([5])	([5])
Natural gas—M cubic feet	1,014,000	794,000	1,543,000	1,223,000	2,010,000	1,568,000
Peat—short tons			514	2,545	676	3,124
Petroleum—barrels	5,118,000	7,080,000	4,868,000	6,890,000	6,726,000	10,750,000
Pyrites—long tons	(1)	(1)	(1)	(1)	(1)	(1)
Rubbing stones and whetstones—short tons	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel—do	6,885,125	3,985,239	6,947,958	4,115,842	8,752,267	5,656,047
Stone—do	4,102,140	4,562,399	4,187,110	6,293,019	5,767,430	9,950,338
Sulfuric acid (60° B.)[6]—do	([1 4])	([1 4])	([1 4])	([1 4])	([1 4])	([1 4])
Miscellaneous [7]		10,653,975		12,303,176		18,169,228
Total value, eliminating duplications		90,465,000		89,856,000		107,800,000

[1] Value included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[3] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] Value not included in total value for State.
[5] No canvass.
[6] From zinc-roasting operation.
[7] Includes minerals indicated by "1" above.

IOWA

Cement—barrels	3,408,616	$5,677,787	3,527,838	$6,220,991	6,145,326	$11,312,627
Clay:						
Products, heavy clay (other than pottery and refractories)		[1] 2,300,000		[1] 3,578,199		[1] 7,095,000
Raw—short tons	[2] 3,705	[2] 31,373	[2] 455,186	[2] 401,870	[2] 696,704	[2] 620,916
Coal—do	2,140,936	7,499,909	2,045,600	7,178,228	1,554,000	5,579,000
Ferro-alloys—do	([3 4])	([3 4])	([3 4])	([3 4])	([3 4])	([3 4])
Gypsum (crude)—do	398,143	655,392	430,843	569,964	560,094	1,172,500

Mineral waters	gallons sold	(5)	(5)	(5)	(5)	(5)	(5)
Peat	short tons	(3)	(3)	(3)	(3)	(3)	(3)
Sand and gravel	do	5,271,031	2,084,149	6,030,531	2,091,391	7,938,572	3,059,792
Stone	do	[6] 3,563,020	[6] 4,175,005	[6] 4,026,460	[6] 5,306,299	5,162,540	6,646,273
Miscellaneous [7]			5,188,469		5,474,196		6,129,222
Total value, eliminating duplications			22,452,000		25,008,000		34,962,000

[1] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[2] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[3] Value included with "Miscellaneous."
[4] Value not included in total value for State.
[5] No canvass.
[6] Exclusive of dimension limestone, value for which is included with "Miscellaneous."
[7] Includes minerals indicated by "3" and "5" above.

KANSAS

Cement	barrels	[1] 2,866,946	[1] $4,454,060	[1] 3,298,923	[1] $5,157,991	[1] 6,894,353	[1] $11,574,910
Clay:							
Products, heavy clay (other than pottery and refractories)			[2] 1,100,000		[2] 1,593,981		[2] 2,771,000
Raw	short tons	([3] [4])	([3] [4])	[4] 254,764	[4] 196,950	[4] 464,033	[4] 283,350
Coal	do	3,369,087	8,684,865	3,228,559	8,310,762	2,650,000	7,473,000
Gypsum (crude)	do	(3)	(3)	(3)	(3)	(3)	(3)
Helium	cubic feet	[5] 38,140,320	[5] 239,140	[5] 58,632,455	[5] 477,268	[5] 2,909,980	[5] 37,742
Lead	short tons	9,394	1,503,040	7,370	1,267,640	6,445	1,405,010
Mineral paints (zinc and lead pigments)	do	([3] [6])	([3] [6])	([3] [6])	([3] [6])	([3] [6])	([3] [6])
Mineral waters	gallons sold	(7)	(7)	(7)	(7)	(7)	(7)
Natural gas	M cubic feet	157,733,000	55,613,000	145,959,000	49,039,000	164,000,000	55,760,000
Natural gasoline and allied products:							
Natural gasoline	gallons	54,045,000	2,600,000	58,309,000	2,687,000	66,289,000	2,525,000
Liquefied petroleum gases	do	15,789,000	525,000	14,328,000	379,000	19,007,000	475,000
Ores (crude), etc.:							
Lead	short tons					3	(8)
Zinc	do	2,351,168	(8)	2,276,525	(8)	1,893,101	(8)
Zinc-lead	do	2,878,627	(8)	2,299,854	(8)	2,401,221	(8)
Petroleum	barrels	98,762,000	120,290,000	96,415,000	119,520,000	97,218,000	138,800,000
Pumice	short tons	43,034	163,538	47,484	187,651	35,466	105,084
Salt	do	932,238	4,357,217	855,806	3,837,850	815,018	4,014,919
Sand and gravel	do	2,786,088	1,602,778	3,082,392	1,674,742	4,443,086	2,505,822
Stone	do	2,121,020	2,069,738	[9] 3,666,000	[9] 2,847,200	3,653,640	3,908,588
Zinc	do	63,703	14,524,284	48,394	11,130,620	47,703	11,639,532
Miscellaneous [10]			3,718,761		3,546,238		5,044,818
Total value, eliminating duplications			217,876,000		208,254,000		243,407,000

[1] Exclusive of natural cement, value for which is included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[3] Value included with "Miscellaneous."
[4] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[5] Figure covers fiscal year ended June 30 of year stated.
[6] Value not included in total value for State.
[7] No canvass.
[8] Not valued as ore; value of recoverable metal content included with the metals.
[9] Exclusive of dimension sandstone, value for which is included with "Miscellaneous."
[10] Includes minerals indicated by "1," "3," and "9" above.

Mineral products of the United States, 1944–46, by States—Continued

KENTUCKY

Product	1944		1945		1946	
	Quantity	Value	Quantity	Value	Quantity	Value
Asphalt (native)—short tons	141,208	$978,279	152,047	$1,037,068	(1)	(1)
Cement—barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)		[2] 900,000		[2] 1,162,696		[2] $1,971,009
Raw—short tons	[3] 372,606	[3] 1,609,478	[3] 485,494	[3] 1,843,987	[3] 735,345	[3] 2,746,906
Coal—do	71,355,997	208,797,140	69,592,936	209,083,518	66,756,000	216,496,000
Coke—do	[1 4]	[1 4]	[1 4]	[1 4]	[1 4]	[1 4]
Fluorspar—do	112,791	3,363,788	95,142	2,832,945	63,143	1,889,454
Iron, pig—do	728,588	[1 4]	631,105	[1 4]	624,174	[1 4]
Lead—do	170	27,200	129	22,188	95	20,710
Mineral waters—gallons sold	[5]	[5]	[5]	[5]	[5]	[5]
Natural gas—M cubic feet	94,223,000	40,392,000	81,714,000	37,078,000	80,000,000	36,800,000
Natural gasoline and allied products:						
Natural gasoline—gallons	10,997,000	650,000	9,395,000	505,000	9,227,000	489,000
Liquefied petroleum gases—do	37,745,000	900,000	37,484,000	817,000	45,064,000	991,000
Ores (crude), etc.:						
Zinc—short tons	715	[6]			15	[6]
Zinc-lead—do	17,230	[6]	6,836	[6]	12,255	[6]
Petroleum—barrels	9,621,000	13,640,000	10,325,000	15,260,000	10,578,000	17,340,000
Sand and gravel—short tons	1,502,096	991,072	1,174,510	1,033,424	2,163,734	1,802,063
Stone—do	3,566,920	3,472,065	[7] 3,470,770	[7] 3,740,716	[7] 4,745,560	[7] 5,205,820
Zinc—do	341	77,748	182	41,860	314	76,616
Miscellaneous [8]		19,946,258		17,165,075		23,208,326
Total value, eliminating duplications		276,701,000		275,487,000		288,606,000

[1] Value included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[3] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] Value not included in total value for State.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included with the metals.
[7] Exclusive of dimension limestone in 1945 and unclassified stone in 1946, values for which are included with "Miscellaneous."
[8] Includes minerals indicated by "1" and "7" above.

LOUISIANA

Cement—barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)		[2] $400,000		[2] $485,710		[2] $857,000
Raw—short tons	[1 3]	[1 3]	[3] 66,891	[3] 69,357	[3] 178,331	[3] 141,526
Lime—do	(1)	(1)	(1)	(1)	(1)	(1)
Magnesium—do	(1)	(1)	(1)	(1)		

Mineral waters	gallons sold	(4)	(4)	(4)	(4)	(4)	(4)
Natural gas	M cubic feet	534, 688, 000	88, 660, 000	542, 789, 000	90, 872, 820	540, 000, 000	90, 180, 000
Natural gasoline and allied products:							
Natural gasoline and cycle products	gallons	409, 824, 000	18, 635, 000	428, 404, 000	14, 299, 000	449, 057, 000	16, 615, 000
Liquefied petroleum gases	do	82, 835, 000	2, 665, 000	120, 830, 000	4, 669, 000	118, 343, 000	4, 497, 000
Petroleum	barrels	129, 645, 000	158, 600, 000	131, 051, 000	161, 260, 000	143, 303, 000	204, 950, 000
Salt	short tons	1, 843, 728	4, 102, 020	1, 867, 689	4, 465, 643	1, 846, 522	4, 612, 359
Sand and gravel	do	2, 646, 789	2, 101, 274	2, 797, 571	2, 585, 945	3, 385, 097	3, 080, 215
Sand and sandstone (ground)	do	(1)	(1)				
Stone	do	1, 079, 150	824, 681	1, 000, 040	756, 341	(1)	(1)
Sulfur	long tons	644, 605	10, 313, 680	763, 479	12, 215, 664	940, 126	15, 042, 016
Miscellaneous [5]			2, 072, 232		2, 323, 193		3, 095, 648
Total value, eliminating duplications			288, 374, 000		293, 963, 000		342, 944, 000

[1] Value included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[3] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] No canvass.
[5] Includes minerals indicated by "1" above.

MAINE

Beryllium concentrates	short tons	2	$257				
Cement	barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:							
Products, heavy clay (other than pottery and refractories)			(1 2)		(1 2)		[3] $191, 000
Raw	short tons			[3] 8, 882	[3] $5, 756	[3] 19, 128	[3] 13, 377
Feldspar (crude)	long tons	8, 011	47, 892	10, 974	62, 287	18, 922	110, 237
Gem stones			(4)		(4)		(4)
Lime	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Lithium minerals	do	(1)	(1)			(1)	(1)
Mica:							
Scrap	do	64	1, 602	32	768	24	607
Sheet	pounds	28, 008	40, 803	(1)	(1)	(1)	(1)
Mineral waters	gallons sold	(4)	(4)	(4)	(4)	(4)	(4)
Peat	short tons	16, 189	84, 727	17, 131	75, 614	22, 522	92, 710
Sand and gravel	do	1, 940, 966	710, 047	1, 888, 778	771, 724	2, 834, 360	925, 308
Silica (quartz)	do	88	203	4	10		
Slate			(1)		(1)		(1)
Stone	short tons	[5] 125, 840	[5] 332, 736	[5] 112, 920	[5] 382, 414	[5] 147, 680	[5] 927, 588
Miscellaneous [6]			932, 131		1, 228, 227		2, 141, 310
Total value, eliminating duplications			2, 150, 000		2, 521, 000		4, 389, 000

[1] Value included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[3] Sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] No canvass.
[5] Exclusive of basalt, value for which is included with "Miscellaneous."
[6] Includes minerals indicated by "1" and "5" above.

Mineral products of the United States, 1944–46, by States—Continued

MARYLAND

Product		1944		1945		1946	
		Quantity	Value	Quantity	Value	Quantity	Value
Cement	barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:							
Products, heavy clay (other than pottery and refractories)			(1 2)		(1 2)		[2] $2,164,000
Raw	short tons	[3] 37,946	[3] $156,562	[3] 208,229	[3] $360,181	[3] 402,232	[3] 497,279
Coal	do	1,870,502	6,410,769	1,762,703	6,361,003	2,010,000	7,759,000
Coke	do	2,058,233	(1 4)	2,024,609	(1 4)	1,661,606	(1 4)
Iron, pig	do	2,514,735	(1 4)	2,244,964	(1 4)	1,945,852	(1 4)
Lime	do	69,514	534,743	66,675	502,376	83,580	692,262
Mineral waters	gallons sold	(5)	(5)	(5)	(5)	(5)	(5)
Perlite	short tons					1,595	8,772
Potassium salts	do	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel	do	3,279,307	2,792,183	2,898,808	2,694,876	4,001,071	3,720,103
Silica (quartz)	do	(1)	(1)	(1)	(1)	(1)	(1)
Slate			(1)		(1)		(1)
Stone	short tons	[6] 1,272,480	[6] 1,756,318	[6] 1,242,930	[6] 1,851,828	[6] 1,715,120	[6] 2,622,618
Talc and ground soapstone	do	17,130	161,222	14,717	(1)	(1)	(1)
Miscellaneous [7]			74,377,780		71,085,247		68,301,982
Total value, eliminating duplications			15,264,000		15,329,000		21,468,000

[1] Value included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[3] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] Value not included in total value for State.
[5] No canvass.
[6] Exclusive of dimension limestone in 1944 and of crushed unclassified stone in 1945 and 1946, values for which are included with "Miscellaneous."
[7] Includes minerals indicated by "1" and "6" above.

MASSACHUSETTS

Beryllium concentrates	short tons	4	$656				
Clay:							
Products, heavy clay (other than pottery and refractories)			[1] 500,000		[1] $506,848		[1] $1,235,000
Raw	short tons	(2 3)	(2 3)	[3] 54,805	[3] 46,895	[3] 100,021	[3] 81,359
Coke	do	1,177,860	(2 4)	1,149,448	(2 4)	1,046,267	(2 4)
Iron, pig	do	(2 4)	(2 4)	(2 4)	(2 4)	9,878	(2 4)
Lime	do	87,295	745,573	94,499	816,733	117,709	1,136,428
Mica:							
Scrap	do	118	2,949	(2)	(2)		
Sheet	pounds	(2)	(2)				
Mineral waters	gallons sold	(5)	(5)	(5)	(5)	(5)	(5)
Peat	short tons	(2)	(2)	(2)	(2)	860	9,725
Sand and gravel	do	2,825,533	1,697,649	2,928,420	1,696,387	4,641,685	2,909,784
Sand and sandstone (ground)	do	2,500	12,000	2,350	11,600	2,000	10,000
Silica (quartz)	do			696	6,349	829	7,715
Stone	do	1,284,070	2,287,050	1,283,310	2,393,390	[6] 1,976,180	[6] 4,135,238

Miscellaneous [7]		13,428,052		12,874,208		12,144,465
Total value, eliminating duplications		5,263,000		5,450,000		9,745,000

[1] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[2] Value included with "Miscellaneous."
[3] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] Value not included in total value for State.
[5] No canvass.
[6] Exclusive of sandstone and unclassified stone, values for which are included with "Miscellaneous."
[7] Includes minerals indicated by "2" and "6" above.

MICHIGAN

Bromine	pounds	17,264,185	$4,918,686	(1)	(1)	14,564,886	$3,736,118
Calcium chloride	short tons	175,740	1,441,882	(1)	(1)	(1)	(1)
Cement	barrels	5,177,176	7,733,185	6,243,322	$9,937,834	9,974,692	16,727,145
Clay:							
Products, heavy clay (other than pottery and refractories)			[2] 1,000,000		[2] 1,248,901		[2] 2,962,000
Raw	short tons	(1 3)	(1 3)	[3] 603,778	[3] 468,417	[3] 1,198,563	[3] 844,576
Coal	do	139,938	762,529	125,704	687,281	108,000	696,000
Coke	do	3,005,424	[4] 24,848,937	2,805,970	[4] 24,119,361	2,499,664	[4] 26,191,476
Copper	pounds	84,842,000	11,453,670	60,802,000	8,208,270	43,326,000	7,018,812
Gem stones			(5)		(5)		(5)
Gypsum (crude)	short tons	552,672	891,965	640,186	862,028	1,120,070	2,171,979
Iron:							
Ore	long tons	13,693,377	38,537,000	11,833,055	35,313,135	8,477,425	28,297,890
Pig	short tons	1,617,912	(1 4)	1,482,037	[4] 26,079,628	1,363,950	[4] 37,081,447
Lime	do	119,446	869,337	(1)	(1)	(1)	(1)
Magnesium	do	(1)	(1)	(1)	(1)	362	148,500
Magnesium compounds (natural)	pounds	269,948,000	6,031,551	98,444,000	2,591,861	122,694,000	3,136,998
Manganiferous ore	short tons	45,689	(1)	1,680	(1)	1,952	(1)
Marl, calcareous	do	(1)	(1)	(1)	(1)	(1)	(1)
Mineral waters	gallons sold	(5)	(5)	(5)	(5)	(5)	(5)
Natural gas	M cubic feet	19,653,000	14,059,000	21,874,000	14,861,000	22,700,000	15,436,000
Natural gasoline and allied products:							
Natural gasoline	gallons	4,055,000	210,000	5,310,000	295,000	4,690,000	216,000
Liquefied petroleum gases	do	4,445,000	147,000	8,320,000	227,000	7,534,000	210,000
Ores (crude), etc.: Copper	short tons	5,410,238	(6)	5,196,932	(6)	4,719,994	(6)
Peat	do	(1)	(1)	6,559	99,752	8,620	122,250
Petroleum	barrels	18,490,000	26,410,000	17,267,000	25,010,000	17,074,000	27,770,000
Potassium salts	short tons					(1)	(1)
Salt	do	4,287,758	14,921,719	4,285,493	14,942,443	4,334,202	15,711,074
Sand and gravel	do	12,184,583	6,103,136	12,199,977	6,107,890	15,593,456	8,939,969
Silver	troy ounces	54,218	38,555	21,863	15,547		
Stone	short tons	15,789,320	8,709,353	[7] 15,493,790	[7] 9,027,267	15,432,320	9,971,003
Miscellaneous [8]			35,760,996		10,334,181		3,011,741
Total value, eliminating duplications			152,162,000		139,832,000		146,355,000

[1] Value included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[3] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] Value not included in total value for State.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included with the metals.
[7] Exclusive of dimension limestone, value for which is included with "Miscellaneous."
[8] Includes minerals indicated by "1" and "7" above.

Mineral products of the United States, 1944–46, by States—Continued

MINNESOTA

Product	1944		1945		1946	
	Quantity	Value	Quantity	Value	Quantity	Value
Cement—barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)		(1 2)		(1 2)		[2] $1,122,000
Raw—short tons	(1 3)	(1 3)	[3] 13,220	[3] $19,717	[3] 62,961	[3] 64,717
Coke—do	894,095	[4] $7,973,653	825,620	[4] 7,760,362	860,754	[4] 8,468,220
Ferro-alloys—do	(1 4)	(1 4)				
Flint lining for tube mills—do	(1)	(1)	(1)	(1)	(1)	(1)
Gem stones		(5)		(5)		(5)
Iron:						
Ore—long tons	65,448,402	160,853,166	61,569,976	156,942,255	49,055,340	142,049,316
Pig—short tons	565,775	(1 4)	465,314	(1 4)	540,057	(1 4)
Lime—do	(1)	(1)	(1)	(1)	(1)	(1)
Manganiferous ore—do	1,267,552	(1)	1,406,847	(1)	1,070,694	2,609,446
Marl, calcareous—do	11,930	3,098	2,970	2,200	1,500	1,200
Millstones				(1)		
Mineral waters—gallons sold	(5)	(5)	(5)	(5)	(5)	(5)
Peat—short tons	(1)	(1)	(1)	(1)	(1)	(1)
Pebbles for grinding—do	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel—do	9,704,152	2,106,804	9,125,117	2,402,530	10,814,635	3,221,434
Stone—do	[6] 1,316,790	[6] 2,245,814	1,173,800	1,962,394	[6] 1,286,800	[6] 3,700,535
Miscellaneous [7]		17,652,822		16,264,417		16,567,825
Total value, eliminating duplications		170,488,000		167,138,000		155,734,000

[1] Value included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[3] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] Value not included in total value for State.
[5] No canvass.
[6] Exclusive of marble and unclassified stone in 1944 and sandstone in 1946, values for which are included with "Miscellaneous."
[7] Includes minerals indicated by "1" and "6" above.

MISSISSIPPI

Clay:						
Products, heavy clay (other than pottery and refractories)		[1] $600,000		[1] $759,400		[1] $1,138,000
Raw—short tons	(2 3)	(2 3)	[3] 212,199	[3] 432,546	[3] 413,562	[3] 732,131
Mineral waters—gallons sold	(4)	(4)	(4)	(4)	(4)	(4)
Natural gas—M cubic feet	1,352,000	336,000	4,587,000	1,076,000	7,200,000	1,656,000
Petroleum—barrels	16,337,000	16,730,000	19,062,000	19,240,000	24,216,000	30,400,000
Sand and gravel—short tons	1,802,479	877,370	1,606,345	812,046	2,619,293	1,533,631

Stone	do	(2)	(2)	(2)	(2)	(2)	(2)
Miscellaneous [9]			397,115		27,761		68,385
Total value, eliminating duplications			18,940,000		22,230,000		35,266,000

[1] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[2] Value included with "Miscellaneous."
[3] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] No canvass.
[5] Includes minerals indicated by "2" above.

MISSOURI

Asphalt (native)	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Barite	do	150,748	$1,121,678	225,467	$1,841,959	270,850	$2,168,067
Cement	barrels	3,061,434	4,881,516	3,681,632	6,134,452	6,887,517	12,142,018
Clay:							
Products, heavy clay (other than pottery and refractories)			[2] 1,400,000		[2] 1,462,818		[2] 3,963,000
Raw	short tons	[3] 927,770	[3] 1,805,495	[3] 1,355,349	[3] 2,311,660	[3] 1,689,229	[3] 3,257,687
Coal	do	4,778,652	12,315,606	3,982,724	10,322,177	3,240,000	9,137,000
Cobalt	pounds	(1)	(1)	(1)	(1)	(1)	(1)
Coke	short tons	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)
Copper	pounds	6,604,000	891,540	6,798,000	917,730	3,714,000	601,668
Iron ore	long tons	19,293	99,560	112,668	(1)	156,350	(1)
Lead	short tons	174,683	27,949,280	176,575	30,370,900	139,112	30,326,416
Lime	do	908,340	5,820,028	753,932	5,031,222	799,742	5,931,485
Mineral paints (zinc and lead pigments)	do	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)
Mineral waters	gallons sold	(5)	(5)	(5)	(5)	(5)	(5)
Natural gas	M cubic feet	159,000	84,000	90,000	47,000	80,000	42,000
Nickel	short tons	(1)	(1)	(1)	(1)		
Ores (crude), etc.:							
Lead	do	6,423,705	(6)	6,509,287	(6)	5,361,694	(6)
Lead-copper	do	122,856	(6)	167,485	(6)	141,698	(6)
Zinc	do	876,198	(6)	849,836	(6)	700,849	(6)
Zinc-lead	do	1,758,333	(6)	1,131,228	(6)	1,297,689	(6)
Petroleum	barrels	45,000	(1)	45,000	(1)	51,000	(1)
Sand and gravel	short tons	3,183,176	2,370,261	3,489,775	2,780,467	5,136,904	4,070,448
Sand and sandstone (ground)	do	(1)	(1)	(1)	(1)	(1)	(1)
Silver	troy ounces	92,243	65,595	94,822	67,429	69,401	56,076
Stone	short tons	4,856,540	5,312,384	[7] 5,314,160	[7] 6,055,747	7,258,990	8,996,440
Sulfuric acid (60° B.) [8]	do	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)
Tripoli	do	(1)	(1)	6,542	114,188	12,180	211,244
Tungsten concentrates (60-percent WO_3 basis)	do	1	(1)				
Zinc	do	36,626	8,350,728	22,175	5,100,250	22,234	5,425,096
Miscellaneous [9]			3,687,908		5,212,889		4,522,383
Total value, eliminating duplications			72,960,000		74,387,000		87,100,000

[1] Value included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[3] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] Value not included in total value for State.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included with the metals.
[7] Exclusive of sandstone, value for which is included with "Miscellaneous."
[8] From zinc smelting.
[9] Includes minerals indicated by "1" and "7" above.

Mineral products of the United States, 1944–46, by States—Continued

MONTANA

Product	1944		1945		1946	
	Quantity	Value	Quantity	Value	Quantity	Value
Arsenious oxide short tons	(1)	(1)	(1)	(1)	(1)	(1)
Bismuth pounds	(2)	(2)	(2)	(2)	(2)	(2)
Calcite (Iceland spar) do	(1)	(1)				
Cement barrels	(1)	(1)	(1)	(1)	(1)	(1)
Chromite short tons	1, 251	$22, 957				
Clay:						
Products, heavy clay (other than pottery and refractories)		(1 3)		(1 3)		3 $191, 000
Raw short tons	(1 4)	(1 4)	4 24, 778	4 $33, 778	4 56, 423	4 187, 201
Coal:						
Bituminous do	4, 792, 340	9, 163, 421	4, 425, 191	8, 322, 004	3, 800, 000	5, 852, 000
Lignite do	51, 709	113, 000	41, 597	99, 000		
Copper pounds	236, 380, 000	31, 911, 300	177, 012, 000	23, 896, 620	116, 962, 000	18, 947, 844
Gem stones		(5)		(5)		(5)
Gold troy ounces	50, 021	1, 750, 735	44, 597	1, 560, 895	70, 507	2, 467, 745
Graphite, crystalline pounds	114, 000	7, 960				
Gypsum (crude) short tons	(1)	(1)	(1)	(1)	(1)	(1)
Lead do	13, 105	2, 096, 800	9, 999	1, 719, 828	8, 280	1, 805, 040
Lime do	(1)	(1)	(1)	(1)	(1)	(1)
Manganese ore do	159, 889	5, 985, 002	151, 930	6, 146, 595	137, 522	4, 643, 050
Manganiferous ore do	781	15, 999	5, 057	(1)	3, 816	(1)
Mica, sheet pounds	(1)	(1)				
Mineral waters gallons sold	(5)	(5)	(5)	(5)	(5)	(5)
Natural gas M cubic feet	32, 102, 000	8, 248, 000	31, 829, 000	8, 648, 000	32, 000, 000	8, 640, 000
Natural gasoline and allied products:						
Natural gasoline gallons	2, 886, 000	200, 000	2, 876, 000	187, 000	2, 634, 000	183, 000
Liquefied petroleum gases do	1, 882, 000	110, 000	1, 850, 000	110, 000	1, 981, 000	109, 000
Ores (crude), etc.:						
Copper short tons	5, 340, 862	(5)	4, 463, 131	(5)	1, 781, 895	(5)
Dry and siliceous (gold and silver) do	231, 399	(5)	188, 713	(5)	149, 611	(5)
Lead do	16, 857	(5)	14, 919	(5)	5, 857	(5)
Zinc do	201, 470	(5)	87, 801	(5)	73, 727	(5)
Zinc-lead do	258, 874	(5)	164, 998	(5)	223, 868	(5)
Petroleum barrels	8, 647, 000	10, 700, 000	8, 420, 000	10, 810, 000	8, 801, 000	12, 710, 000
Phosphate rock long tons	186, 434	761, 745	150, 858	916, 288	179, 944	1, 207, 054
Platinum metals (crude) troy ounces	9	(1)				
Pyrites long tons	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel short tons	4, 308, 811	1, 956, 449	7 2, 035, 192	7 1, 067, 295	2, 428, 681	1, 301, 867
Silver troy ounces	7, 093, 215	5, 044, 064	5, 942, 070	4, 225, 472	3, 273, 140	2, 644, 697
Stone short tons	8 232, 090	8 229, 160	646, 850	563, 374	441, 480	440, 046
Talc do	(1)	(1)	(1)	(1)	(1)	(1)
Tungsten concentrates (60-percent WO_3 basis) do	25	(1)	(9)	(1)	84	(1)
Vermiculite do	(1)	(1)	(1)	(1)	(1)	(1)

Zinc	do	36,127	8,236,956	17,403	4,002,690	16,770	4,091,880
Miscellaneous [10]			2,498,254		3,693,239		3,235,005
Total value, eliminating duplications			89,052,000		75,978,000		68,630,000

[1] Value included with "Miscellaneous."
[2] Figure not available.
[3] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945-46: Figures obtained through cooperation with Bureau of the Census.
[4] 1944, sold or shipped. 1945-46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included with the metals.
[7] "Commercial." Value of "Government-and-contractor" included with "Miscellaneous."
[8] Exclusive of dimension basalt, value for which is included with "Miscellaneous."
[9] 147 pounds.
[10] Includes minerals indicated by "[1]," "[7]," and "[8]" above.

NEBRASKA

Cement	barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:							
Products, heavy clay (other than pottery and refractories)			[2] $320,000		[2] $281,357		[2] $802,000
Raw	short tons	([1 3])	([1 3])	[3] 36,415	[3] 34,757	[3] 130,586	[3] 112,985
Mineral waters	gallons sold	(4)	(4)	(4)	(4)	(4)	(4)
Petroleum	barrels	417,000	460,000	305,000	370,000	265,000	360,000
Pumice	short tons	6,083	51,043	6,764	59,735	4,772	45,900
Sand and gravel	do	3,894,983	1,896,777	3,882,461	1,956,560	3,969,811	1,962,560
Stone	do	169,720	483,563	297,750	622,671	263,930	612,120
Miscellaneous			1,848,814		1,671,419		3,452,178
Total value, eliminating duplications			5,060,000		4,963,000		7,237,000

[1] Value included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945-46: Figures obtained through cooperation with Bureau of the Census.
[3] 1944, sold or shipped. 1945-46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] No canvass.

NEVADA

Antimony ore (concentrates)	short tons	74	$6,593	65	$6,402	15	$1,593
Arsenious oxide	do	(1)	(1)	(1)	(1)	(1)	(1)
Barite	do	22,390	84,859	28,919	106,052	(2)	(2)
Bismuth	pounds	(1)	(1)	(1)	(1)	(1)	(1)
Clay:							
Products, heavy clay (other than pottery and refractories)			([2 3])		([2 3])		([2 3])
Raw	short tons	(2)	(2)			(2)	(2)
Copper	pounds	122,464,000	16,532,640	105,190,000	14,200,650	97,232,000	15,751,584
Diatomite	short tons	(2)	(2)	(2)	(2)	(2)	(2)
Dumortierite	do	(2)	(2)	(2)	(2)		
Fluorspar	do	7,293	(2)	7,038	(2)	6,234	(2)
Fuller's earth	do	(2)	(2)	(2)	(2)	(2)	(2)
Gem stones			(4)		(4)		(4)
Gold	troy ounces	119,056	4,166,960	92,265	3,229,275	90,680	3,173,800
Gypsum (crude)	short tons	392,748	693,107	368,246	732,253	490,253	1,164,083
Iron ore	long tons	32,281	230,684	6,196	(2)	3,299	(2)
Lead	short tons	6,605	1,056,800	6,275	1,079,300	7,175	1,564,150

See footnotes at end of table.

Mineral products of the United States, 1944–46, by States—Continued

NEVADA—Continued

Product	1944		1945		1946	
	Quantity	Value	Quantity	Value	Quantity	Value
Lime, short tons	(2)	(2)	(2)	(2)	(2)	(2)
Magnesite, do	(2)	(2)	(2)	(2)	(2)	(2)
Magnesium, do	33,368	$13,947,785	423	$118,926		
Magnesium oxide (hydrated) (brucite), do	(2)	(2)	(2)	(2)	(2)	(2)
Manganese ore, do	21,799	900,010	960	(2)	1,064	(2)
Manganiferous ore, do	7,492	(2)	2,212	(2)	12,468	(2)
Marl, calcareous, do	(2)	(2)	(2)	(2)	(2)	(2)
Mercury, flasks (76 pounds)	2,460	291,166	4,338	585,153	4,567	$448,662
Mica, sheet, pounds	(2)	(2)	(2)	(2)		
Mineral waters, gallons sold	(4)	(4)	(4)	(4)	(4)	(4)
Molybdenum, pounds	(2)	(2)	(2)	(2)	(2)	(2)
Ores (crude), etc.:						
Copper, short tons	6,181,967	(5)	4,917,945	(5)	5,102,212	(5)
Dry and siliceous (gold and silver), do	425,659	(5)	202,767	(5)	329,575	(5)
Lead, do	13,993	(5)	12,707	(5)	14,468	(5)
Zinc, do	225,019	(5)	94,029	(5)	11,306	(5)
Zinc-lead, do	16,867	(5)	147,225	(5)	268,244	(5)
Quartz crystal, pounds	(1)	(1)				
Salt, short tons	(2)	(2)	(2)	(2)	(2)	(2)
Sand and gravel, do	983,074	713,302	999,781	914,476	720,506	944,332
Silver, troy ounces	1,259,636	895,741	1,043,380	741,959	1,250,651	1,010,526
Stone, short tons	90,590	138,954	104,180	151,673	6 87,810	6 122,940
Sulfur ore, long tons					42	3,396
Talc, pinite, and pyrophyllite, short tons	9,590	150,325	11,780	185,059	7,589	141,180
Tungsten concentrates (60-percent WO_3 basis), do	2,665	3,902,893	1,857	2,658,390	2,617	3,321,161
Vermiculite, do					(2)	(2)
Zinc, do	20,699	4,719,372	21,457	4,935,110	22,649	5,526,356
Miscellaneous [7]		3,368,809		1,662,459		2,280,002
Total value, eliminating duplications		51,800,000		31,307,000		35,454,000

[1] Figure not available.
[2] Value included with "Miscellaneous."
[3] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included with the metals.
[6] Exclusive of limestone, value for which is included with "Miscellaneous."
[7] Includes minerals indicated by "2" and "6" above.

NEW HAMPSHIRE

Beryllium concentrates, short tons	(1)	(1)	1	$357	5	$365
Clay:						
Products, heavy clay (other than pottery and refractories)		(1 3)		(1 3)		(1 3)
Raw, short tons					3 18,108	3 12,381
Feldspar (crude), long tons	(1)	(1)	(1)	(1)	(1)	(1)

Gem stones			[4]		[4]		[4]
Mica:							
Scrap	short tons	2,339	$55,851	442	11,206	[1]	[1]
Sheet	pounds	323,636	617,172	532,944	144,947	377,650	41,589
Mineral waters	gallons sold	[4]	[4]	[4]	[4]	[4]	[4]
Peat	short tons	[1]	[1]	[1]	[1]	[1]	[1]
Sand and gravel	do	838,668	120,943	[3] 943,076	[3] 93,812	[3] 1,434,880	[3] 138,789
Soythestones	do	[4]	[4]	[4]	[4]	[4]	[4]
Stone	do	910	48,000	3,760	93,089	68,530	385,828
Miscellaneous [6]			322,483		458,150		884,624
Total value, eliminating duplications			1,164,000		802,000		1,451,000

[1] Value included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[3] Sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] No canvass.
[5] "Government-and-contractor." Value of "Commercial" included with "Miscellaneous."
[6] Includes minerals indicated by "1" and "2" above.

NEW JERSEY

Aluminum	short tons	[1 2]	[1 2]				
Clay:							
Products, heavy clay (other than pottery and refractories)			[3] $3,500,000		[3] $1,808,723		[3] $3,780,000
Raw	short tons	[4] 98,903	[4] 600,331	[4] 252,664	[4] 794,564	[4] 488,161	[4] 1,296,358
Coke	do	1,022,917	[1 2]	1,284,020	[1 2]	1,258,854	[1 2]
Ferro-alloys	do	[1 2]	[1 2]	[1 2]	[1 2]	[1 2]	[1 2]
Iron ore	long tons	498,799	3,455,213	428,747	2,956,510	419,274	3,052,831
Lime	short tons	[1]	[1]	[1]	[1]	[1]	[1]
Magnesium oxide (magnesia)	pounds	[1]	[1]	[1]	[1]	[1]	[1]
Manganiferous residuum	short tons	247,402	[1]	224,331	[1]	205,786	[1]
Marl, greensand	do	4,908	505,651	4,986	477,919	5,140	424,900
Mineral paints (zinc and lead pigments)	do	[1 2]	[1 2]	[1 2]	[1 2]	[1 2]	[1 2]
Mineral waters	gallons sold	[5]	[5]	[5]	[5]	[5]	[5]
Ore (zinc)	short tons	543,007	[6]	522,177	[6]	413,755	[6]
Peat	do	15,025	116,511	[1]	[1]	20,902	127,550
Sand and gravel	do	[7] 4,514,374	[7] 5,081,861	4,506,379	4,652,938	5,123,324	5,404,206
Sand and sandstone (ground)	do	[1]	[1]	[1]	[1]	105,985	649,828
Silica (quartz)	do	[1]	[1]	[1]	[1]		
Stone	do	2,211,690	3,321,978	[8] 2,261,750	[8] 3,498,182	3,419,210	5,239,342
Zinc [9]	do	80,288	14,080,644	81,392	14,299,032	64,454	11,701,346
Miscellaneous [10]			15,521,134		14,496,937		15,260,706
Total value, eliminating duplications			33,828,000		31,267,000		33,518,000

[1] Value included with "Miscellaneous."
[2] Value not included in total value for State.
[3] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[4] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included with the metal.
[7] "Commercial." Value of "Government-and-contractor" included with "Miscellaneous."
[8] Exclusive of dimension basalt, value for which is included with "Miscellaneous."
[9] Value reported for zinc in New Jersey is estimated smelting value of recoverable zinc content of ore after freight, haulage, smelting, and manufacturing charges are added.
[10] Includes minerals indicated by "1," "7," and "8" above.

Mineral products of the United States, 1944–46, by States—Continued

NEW MEXICO

Product		1944		1945		1946	
		Quantity	Value	Quantity	Value	Quantity	Value
Arsenious oxide	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Beryllium concentrates	do	29	$3,789				
Bismuth	pounds	(1)	(1)	(1)	(1)	(1)	(1)
Clay:							
Products, heavy clay (other than pottery and refractories)			(2 3)		(2 3)		[3] $148,000
Raw	short tons	[4] 5,622	[4] 19,933	[4] 22,200	[4] $30,720	[4] 39,013	[4] 43,487
Coal	do	1,743,674	6,604,398	1,483,686	5,637,434	1,250,000	5,206,000
Copper	pounds	139,460,000	18,827,100	113,142,000	15,274,170	100,382,000	16,261,884
Fluorspar	short tons	42,973	1,205,830	14,449	390,331	17,584	489,607
Gem stones			(5)		(5)		(5)
Gold	troy ounces	6,918	242,130	5,604	196,140	4,009	140,316
Helium	cubic feet	[6] 2,243,414	[6] 14,066				
Iron ore	long tons	33,460	(2)	369	(2)		
Lead	short tons	7,265	1,162,400	7,662	1,317,864	4,899	1,067,982
Lime	do	(2)	(2)	(2)	(2)		
Lithium minerals	do					(2)	(2)
Magnesium chloride (natural)	pounds	(2)	(2)				
Manganese ore	short tons	273	7,155	3,334	(2)	1,166	(2)
Manganiferous ore	do	100,683	(2)	85,744	(2)	72,299	(2)
Mica:							
Scrap	do	816	14,574	491	9,082		
Sheet	pounds	3,347	8,893	(2)	(2)		
Mineral waters	gallons sold	(5)	(5)	(5)	(5)	(5)	(5)
Molybdenum	pounds	(2)	(2)	(2)	(2)	(2)	(2)
Natural gas	M cubic feet	87,727,000	13,980,000	105,023,000	16,173,000	126,000,000	18,774,000
Natural gasoline and allied products:							
Natural gasoline	gallons	69,528,000	3,345,000	86,043,000	4,794,000	87,693,000	3,771,000
Liquefied petroleum gases	do	11,633,000	326,000	11,757,000	257,000	15,393,000	339,000
Ores (crude), etc.:							
Copper	short tons	7,207,554	(7)	6,228,727	(7)	6,044,004	(7)
Dry and siliceous (gold and silver)	do	2,265	(7)	14,483	(7)	11,228	(7)
Lead	do	4,277	(7)	4,627	(7)	737	(7)
Zinc	do	6,332	(7)	265,931	(7)	487,063	(7)
Zinc-lead	do	723,418	(7)	329,559	(7)	51,858	(7)
Petroleum	barrels	39,555,000	39,600,000	37,351,000	37,610,000	36,860,000	44,650,000
Potassium salts	short tons	[8] 679,721	24,739,507	[8] 733,176	25,456,731	[8] 789,473	27,187,228
Pumice	do	(2)	(2)	(2)	(2)	62,623	432,890
Salt	do	23,759	105,860	9,980	20,694	3,677	16,399
Sand and gravel	do	439,286	292,601	[9] 448,438	[9] 317,968	[9] 349,688	[9] 278,442
Silver	troy ounces	535,275	380,640	465,127	330,757	338,000	273,104
Stone	short tons	[10] 609,240	[10] 334,357	361,700	173,120	(2)	(2)
Talc	do	(2)	(2)	(2)	(2)		

Tantalum and columbium ores	pounds	(2)	(2)	(2)	(2)	1,772	5,547
Tin (metallic equivalent)	short tons	(2)	(2)				
Tungsten concentrates (60-percent WO_3 basis)	do	9	(2)				
Vanadium	pounds	(3)	(2)				
Zinc	short tons	50,727	11,555,756	40,295	9,267,850	36,103	8,809,132
Miscellaneous [11]			2,046,610		1,702,895		1,184,025
Total value, eliminating duplications			124,827,000		118,947,000		129,044,000

[1] Figure not available.
[2] Value included with "Miscellaneous."
[3] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[4] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[5] No canvass.
[6] Figure covers fiscal year ended June 30 of year stated.
[7] Not valued as ore; value of recoverable metal content included with the metals.
[8] Equivalent as K_2O.
[9] "Commercial." Value of "Government-and-contractor" included with "Miscellaneous."
[10] Exclusive of sandstone, value for which is included with "Miscellaneous."
[11] Includes minerals indicated by "2," "9," and "10" above.

NEW YORK

Aluminum	short tons	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)
Cement	barrels	[3] 4,411,695	[3] $6,839,676	[3] 5,578,906	[3] $9,009,454	[3] 10,514,431	[3] $17,547,319
Clay:							
Products, heavy clay (other than pottery and refractories)			[4] 1,500,000		[4] 2,376,670		[4] 7,289,000
Raw	short tons	(1 5)	(1 5)	[5] 320,683	[5] 272,302	[5] 1,137,105	[5] 840,143
Coke	do	6,102,560	[2] 47,155,591	5,789,974	[2] 46,676,238	5,042,674	[2] 44,316,777
Diatomite	do	(1)	(1)	(1)	(1)	(1)	(1)
Emery	do	6,940	64,858	7,856	75,977	6,188	62,099
Feldspar (crude)	long tons	(1)	(1)	(1)	(1)	(1)	(1)
Ferro-alloys	short tons	324,302	[2] 55,670,642	286,895	[2] 48,245,824	321,817	[2] 45,255,465
Garnet, abrasive	do	(1)	(1)	(1)	(1)	(1)	(1)
Gem stones			(6)		(6)		(6)
Graphite, artificial	pounds	(1 2)	(1 2)			(1 2)	(1 2)
Gypsum (crude)	short tons	594,067	1,128,821	557,902	1,262,989	814,999	1,961,157
Iron:							
Ore	long tons	(1)	(1)	(1)	(1)	(1)	(1)
Pig	short tons	3,836,078	[2] 76,575,005	3,278,345	[2] 74,857,092	2,801,828	[2] 63,937,403
Lead	do	1,644	263,040	862	148,264	1,073	233,914
Lime	do	193,395	1,410,956	(1)	(1)	(1)	(1)
Magnesium	do	1,380	565,800				
Mica, scrap	do					(1)	(1)
Millstones			(1)		3,577		(1)
Mineral waters	gallons sold	(6)	(6)	(6)	(6)	(6)	(6)
Natural gas	M cubic feet	7,052,000	5,164,000	9,210,000	5,919,000	9,000,000	6,030,000
Natural gasoline	gallons	12,000	1,000	8,000	(1)	8,000	(1)
Ores (crude), etc.:							
Zinc	short tons	120,106	(7)	97,040	(7)	130,069	(7)
Zinc-lead	do	303,451	(7)	228,062	(7)	262,197	(7)
Peat	do	(1)	(1)	(1)	(1)	(1)	(1)

See footnotes at end of table.

Mineral products of the United States, 1944–46, by States—Continued

NEW YORK—Continued

Product		1944		1945		1946	
		Quantity	Value	Quantity	Value	Quantity	Value
Petroleum	barrels	4,697,000	$15,640,000	4,648,000	$17,470,000	4,863,000	$18,650,000
Pyrites	long tons	(1)	(1)	(1)	(1)	(1)	(1)
Salt	short tons	2,925,675	9,899,580	2,862,224	10,327,013	2,813,782	10,153,274
Sand and gravel	do	7,049,583	4,308,390	7,477,628	5,049,905	12,079,249	8,907,100
Silver	troy ounces	25,238	17,947	14,271	10,148	15,786	12,755
Slate			791,093		(1)		1,160,404
Stone	short tons	7,454,160	8,073,778	7,900,560	9,133,781	9,939,440	12,086,748
Talc	do	(1)	(1)	(1)	(1)	(1)	(1)
Titanium concentrates: Ilmenite	do	216,253	(1)	240,090	(1)	209,009	(1)
Wollastonite	do	(1)	(1)	(1)	(1)	(1)	(1)
Zinc	do	35,541	8,103,348	24,978	5,744,940	32,515	7,933,660
Miscellaneous [8]			64,911,555		46,310,583		37,604,558
Total value, eliminating duplications			87,638,000		91,968,000		108,270,000

[1] Value included with "Miscellaneous."
[2] Value not included in total value for State.
[3] Exclusive of natural cement, value for which is included with "Miscellaneous."
[4] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[5] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included with the metals.
[8] Includes minerals indicated by "1" and "3" above.

NORTH CAROLINA

Aluminum	short tons	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)
Asbestos	do	(1)	(1)	(1)	(1)	(1)	(1)
Barite	do	(1)	(1)	(1)	(1)		
Beryllium concentrates	do	(1)	(1)				
Bromine	pounds	(1)	(1)	(1)	(1)		
Clay:							
Products, heavy clay (other than pottery and refractories)			[3] $2,700,000		[3] $3,471,219		[3] $6,241,000
Raw	short tons	[4] 25,663	[4] 423,821	[4] 525,506	[4] 783,220	[4] 914,999	[4] 1,178,030
Copper	pounds	(1)	(1)				
Feldspar (crude)	long tons	122,857	778,007	148,493	863,740	230,367	1,200,638
Flint lining for tube mills	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Gem stones			(5)		(5)		(5)
Gold	troy ounces	21	735				
Lime	short tons	(1)	(1)	(1)	(1)		
Lithium minerals	do	(1)	(1)	(1)	(1)		

Mica:							
Scrap	do	29,774	750,285	30,682	709,334	39,100	887,901
Sheet	pounds	814,874	1,530,625	563,990	243,058	424,791	135,505
Millstones			(1)		(1)		(1)
Mineral waters	gallons sold	(5)	(5)	(5)	(5)	(5)	(5)
Olivine	short tons	3,270	35,207	(1)	(1)	6,249	(1)
Ores (crude): Copper	do	6,438	(6)				
Pebbles for grinding	do	(1)	(1)				
Quartz crystal	pounds	(7)	(7)	3,644	116,300	(1)	(1)
Sand and gravel	short tons	2,535,601	1,405,917	2,394,089	1,517,203	4,213,795	2,933,711
Sand and sandstone (ground)	do	(1)	(1)				
Silica (quartz)	do	(1)	(1)	(1)	(1)	(1)	(1)
Silver	troy ounces	1,461	1,039				
Stone	short tons	4,659,540	5,975,951	[8] 2,297,670	[8] 2,965,458	4,505,880	6,835,448
Talc, pyrophyllite, and ground soapstone	do	69,892	645,156	78,369	682,510	87,718	976,524
Tantalum and columbium ores: Columbium ore	pounds	(1)	(1)	(1)	(1)		
Tin (metallic equivalent)	do	100	50				
Titanium concentrates: Ilmenite	short tons	16,333	(1)	17,216	(1)	17,852	(1)
Tungsten concentrates (60-percent WO_3 basis)	do	186	(1)	132	(1)	307	(1)
Vermiculite	do	(1)	(1)	(1)	(1)	(1)	(1)
Miscellaneous [9]			17,221,581		12,668,510		7,685,377
Total value, eliminating duplications			22,199,000		14,766,000		20,428,000

[1] Value included with "Miscellaneous."
[2] Value not included in total value for State.
[3] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[4] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included with the metals.
[7] Figure not available.
[8] Exclusive of marble and sandstone, values for which are included with "Miscellaneous."
[9] Includes minerals indicated by "1" and "8" above.

NORTH DAKOTA

Clay:							
Products, heavy clay (other than pottery and refractories)			(1 2)		(1 2)		(1 2)
Raw	short tons	(1 3)	(1 3)	[3] 6,026	[3] $4,450	(1 3)	(1 3)
Coal	do	2,366,092	$3,535,000	2,522,319	3,924,000	2,691,000	$4,655,000
Mineral waters	gallons sold	(4)	(4)	(4)	(4)	(4)	(4)
Natural gas	M cubic feet	200,000	65,000	217,000	80,000	315,000	126,000
Sand and gravel	short tons	2,127,029	733,340	1,769,086	523,163	2,304,694	726,422
Miscellaneous [5]			60,024		50,514		90,680
Total value, eliminating duplications			4,393,000		4,578,000		5,587,000

[1] Value included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[3] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] No canvass.
[5] Includes minerals indicated by "1" above.

Mineral products of the United States, 1944–46, by States—Continued

OHIO

Product	1944		1945		1946	
	Quantity	Value	Quantity	Value	Quantity	Value
Bromine ... pounds	13,404	$2,653				
Calcium chloride ... short tons	1,253	7,092				
Cement ... barrels	4,129,017	5,957,819	4,833,183	$7,356,271	8,187,531	$13,293,126
Clay:						
Products, heavy clay (other than pottery and refractories)		[1] 12,000,000		[1] 18,609,369		[1] 39,729,000
Raw ... short tons	[2] 642,786	[2] 1,340,809	[2] 2,385,764	[2] 4,048,315	[2] 4,047,818	[2] 6,113,837
Coal ... do	33,877,055	89,699,797	32,737,435	91,440,597	32,848,000	100,675,000
Coke ... do	10,338,913	[3] 70,781,105	9,405,710	[3] 70,381,885	8,451,580	[3] 69,357,225
Ferro-alloys ... do	232,831	[3] 14,426,924	189,619	[3] 11,166,247	201,682	[3] 8,884,960
Grindstones ... do	(4)	(4)	9,534	385,140	10,854	478,022
Gypsum (crude) ... do	(4)	(4)	(4)	(4)	(4)	(4)
Iron, pig ... do	13,400,053	[3] 294,265,267	11,264,024	[3] 258,959,815	9,647,981	[3] 240,218,956
Lime ... do	1,467,575	11,876,409	1,420,983	11,693,615	1,469,278	12,926,310
Magnesium ... do	(4)	(4)	(4)	(4)		
Mineral paints (zinc and lead pigments) ... do	(3 4)	(3 4)	(3 4)	(3 4)	(3 4)	(3 4)
Mineral waters ... gallons sold	(5)	(5)	(5)	(5)	(5)	(5)
Natural gas ... M cubic feet	51,724,000	26,783,000	49,967,000	25,973,000	56,000,000	29,400,000
Natural gasoline ... gallons	7,282,000	440,000	6,452,000	369,000	6,344,000	285,000
Peat ... short tons	13,638	147,504	14,434	131,688	18,979	161,444
Petroleum ... barrels	2,937,000	6,560,000	2,828,000	7,240,000	2,908,000	7,910,000
Salt ... short tons	2,891,395	4,076,481	2,764,926	3,997,759	2,645,995	4,160,011
Sand and gravel ... do	10,327,012	8,866,549	9,420,380	7,985,018	13,266,074	11,105,652
Sand and sandstone (ground) ... do	(4)	(4)	(4)	(4)	(4)	(4)
Scythestones, whetstones, etc ... do	(4)	(4)	347	24,256	249	51,135
Stone ... do	[6] 15,048,230	[6] 15,292,705	[6] 13,279,800	[6] 13,966,710	[6] 16,991,440	[6] 19,069,169
Sulfuric acid (60° B.) [7] ... do	(3 4)	(3 4)	(3 4)	(3 4)	(3 4)	(3 4)
Miscellaneous [8]		11,827,485		7,446,925		3,774,430
Total value, eliminating duplications		192,194,000		196,756,000		243,637,000

[1] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[2] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[3] Value not included in total value for State.
[4] Value included with "Miscellaneous."
[5] No canvass.
[6] Exclusive of unclassified stone, 1944–45 and dimension limestone in 1946, values for which are included with "Miscellaneous."
[7] From zinc-roasting operation.
[8] Includes minerals indicated by "4" and "6" above.

Asphalt (native)	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Cement	barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:							
Products, heavy clay (other than pottery and refractories)			[2] $600,000		[2] $707,272		[2] $1,557,000
Raw	short tons	([1] [3])	([1] [3])	[3] 243,358	[3] 178,658	[3] 488,973	[3] 358,922
Coal	do	3,208,534	11,135,485	2,908,976	10,487,344	2,510,000	9,497,000
Gypsum (crude)	do	(1)	(1)	(1)	(1)	(1)	(1)
Lead	do	13,944	2,231,040	12,664	2,178,208	13,697	2,985,946
Lime	do	(1)	(1)	(1)	(1)	(1)	(1)
Mineral waters	gallons sold	(4)	(4)	(4)	(4)	(4)	(4)
Natural gas	M cubic feet	310,888,000	46,346,000	357,530,000	66,014,000	380,000,000	76,000,000
Natural gasoline and allied products:							
Natural gasoline	gallons	301,246,000	17,200,000	284,334,000	15,223,000	285,021,000	12,919,000
Liquefied petroleum gases	do	120,522,000	3,400,000	131,850,000	3,276,000	133,942,000	3,081,000
Ores (crude), etc.:							
Lead	short tons	14	(5)	6	(5)	2,236	(5)
Zinc	do	9,908,605	(5)	9,545,153	(5)	9,067,673	(5)
Zinc-lead	do	3,703,111	(5)	2,640,147	(5)	3,139,744	(5)
Petroleum	barrels	124,616,000	153,290,000	139,299,000	177,050,000	134,497,000	193,600,000
Salt	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel	do	1,364,604	746,207	1,274,186	761,448	1,577,138	947,283
Stone	do	4,563,270	1,799,765	3,894,720	1,572,772	3,413,430	2,624,579
Sulfuric acid (60° B.) [6]	do	([1] [7])	([1] [7])	([1] [7])	([1] [7])	([1] [7])	([1] [7])
Zinc	do	91,449	20,850,372	69,300	15,939,000	69,552	16,970,688
Miscellaneous [8]			3,606,355		3,716,517		6,359,531
Total value, eliminating duplications			260,832,000		296,564,000		326,148,000

[1] Value included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[3] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included with the metals.
[6] From zinc smelting.
[7] Value not included in total value for State.
[8] Includes minerals indicated by "1" above.

Mineral products of the United States, 1944–46, by States—Continued

OREGON

Product	1944		1945		1946	
	Quantity	Value	Quantity	Value	Quantity	Value
Aluminum—short tons	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)
Antimony ore (concentrates)—do	1,202	$16,089	436	$9,894	10	$1,593
Arsenious oxide—do	(3)	(3)				
Asbestos—do	(1)	(1)				
Cement—barrels	(1)	(1)	(1)	(1)	(1)	(1)
Chromite—short tons	7,818	312,096	4,366	167,667	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)		4 400,000		4 463,647		4 788,000
Raw—short tons	(1 5)	(1 5)	5 128,484	5 93,357	5 118,478	5 90,044
Coal—do	1,453	8,718	16,500	65,786	12,000	52,000
Copper—pounds	6,000	810	2,000	270	14,000	2,268
Diatomite—short tons	(1)	(1)	(1)	(1)	(1)	(1)
Ferro-alloys—do	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)
Gem stones		(6)		(6)		(6)
Gold—troy ounces	1,369	47,915	4,467	156,345	17,598	615,930
Lead—short tons	4	640	1	172	2	436
Lime—do	(1)	(1)	(1)	(1)	(1)	(1)
Mercury—flasks (76 pounds)	3,159	373,899	2,500	337,225	1,326	130,266
Mineral waters—gallons sold	(6)	(6)	(6)	(6)	(6)	(6)
Ores (crude), etc.:						
Copper—short tons					152	(7)
Dry and siliceous (gold and silver)—do	4,217	(7)	1,378	(7)	3,094	(7)
Platinum metals (crude)—troy ounces			3	(1)		
Pumice—short tons	(1)	(1)	(1)	(1)	3,004	12,532
Sand and gravel—do	4,601,163	3,752,671	4,476,504	3,681,255	5,419,183	4,578,672
Silica (quartz)—do	(1)	(1)	1,462	16,260	(1)	(1)
Silver—troy ounces	20,243	14,395	10,461	7,439	6,927	5,597
Stone—short tons	1,947,230	2,378,142	8 1,498,160	8 1,898,073	8 1,472,700	8 2,008,374
Zinc—do			1	230		
Miscellaneous 9		17,756,962		11,230,845		6,535,529
Total value, eliminating duplications		9,657,000		9,463,000		11,783,000

1 Value included with "Miscellaneous."
2 Value not included in total value for State.
3 Figure not available.
4 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
5 1944, sold or shipped, 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
6 No canvass.
7 Not valued as ore; value of recoverable metal content included with the metals.
8 Exclusive of sandstone and unclassified stone in 1945 and granite and dimension basalt in 1946, values for which are included with "Miscellaneous."
9 Includes minerals indicated by "1," and "8" above.

Cement	barrels	[1] 13,918,172	[1] $20,689,765	16,232,722	$25,549,621	29,686,909	$48,294,891
Clay:							
Products, heavy clay (other than pottery and refractories)			[2] 6,000,000		[2] 8,233,763		[2] 18,764,000
Raw	short tons	[3] 989,035	[3] 2,712,458	[3] 2,191,536	[3] 5,347,951	[3] 3,178,011	[3] 6,943,203
Coal:							
Anthracite	do	63,701,363	354,582,884	54,933,909	323,944,435	60,506,873	413,417,070
Bituminous	do	146,052,415	459,508,954	132,965,343	436,823,651	125,155,000	454,926,000
Cobalt	pounds	[4]	[4]	[4]	[4]	[4]	[4]
Coke	short tons	23,147,471	[5] 144,654,808	19,838,857	[5] 131,395,424	16,821,888	[5] 121,817,080
Copper [6]	pounds	[4]	[4]	[4]	[4]	[4]	[4]
Feldspar (crude)	long tons	[4]	[4]	[4]	[4]		
Ferro-alloys	short tons	692,781	[5] 110,626,554	594,888	[5] 88,579,690	444,442	[5] 58,712,282
Gem stones			[7]		[7]		[7]
Gold [6]	troy ounces	2,115	74,025	1,588	55,580	1,150	40,250
Graphite, crystalline	pounds					[4]	[4]
Iron:							
Ore	long tons	[4]	[4]	[4]	[4]	[4]	[4]
Pig	short tons	18,503,427	[5] 397,395,665	16,168,496	[5] 361,684,919	13,330,186	[5] 329,194,957
Lime	do	1,026,292	7,933,361	903,914	7,221,808	972,311	8,272,202
Mica, scrap	do	[4]	[4]	286	1,430		
Mineral paints (zinc and lead pigments)	do	[4 8]	[4 8]	[4 8]	[4 8]	[4 8]	[4 8]
Mineral waters	gallons sold	[7]	[7]	[7]	[7]	[7]	[7]
Natural gas	M cubic feet	92,987,000	45,542,000	82,188,000	43,094,000	85,000,000	45,050,000
Natural gasoline and allied products:							
Natural gasoline	gallons	17,023,000	990,000	13,588,000	752,000	10,726,000	526,000
Liquefied petroleum gases	do	472,000	42,000	593,000	51,000	540,000	46,000
Peat	short tons	2,124	8,780	[4]	[4]	2,952	9,615
Petroleum	barrels	14,118,000	46,400,000	12,515,000	46,680,000	12,996,000	49,470,000
Pyrites	long tons	[4]	[4]	[5]	[4]	[5]	[4]
Sand and gravel	short tons	6,919,406	7,265,943	6,768,944	7,247,613	10,773,213	10,984,330
Sand and sandstone (ground)	do	[4]	[4]	[4]	[4]	[4]	[4]
Silver [6]	troy ounces	13,545	9,632	10,434	7,420	7,887	6,373
Slate			1,827,896		1,929,741		3,197,745
Soapstone	short tons	[4]	[4]	[4]	[4]	[4]	[4]
Stone	do	[8] 18,175,280	[8] 22,516,282	[8] 17,708,390	[8] 22,266,706	18,883,740	25,872,596
Sulfuric acid (60° B.) [9]	do	353,094	[5] 3,509,754	346,387	[5] 3,498,509	295,353	[5] 2,882,645
Tripoli (rottenstone)	do	[4]	[4]	561	8,452	1,144	16,255
Miscellaneous [10]			24,626,924		22,221,467		25,858,979
Total value, eliminating duplications			985,452,000		936,157,000		1,090,784,000

[1] Exclusive of natural cement, value for which is included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[3] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] Value included with "Miscellaneous."
[5] Value not included in total value for State.
[6] Copper, gold, and silver were recovered from magnetite-pyrite-chalcopyrite ore, which is included as iron ore produced. Bureau of Mines not at liberty to publish figures.
[7] No canvass.
[8] Exclusive of crushed granite, value for which is included with "Miscellaneous."
[9] From zinc smelting.
[10] Includes minerals indicated by "1," "4," and "8" above.

Mineral products of the United States, 1944–46, by States—Continued

RHODE ISLAND

Product	1944		1945		1946	
	Quantity	Value	Quantity	Value	Quantity	Value
Coke—short tons	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)
Graphite, amorphous—do	(1)	(1)	(1)	(1)	(1)	(1)
Mineral waters—gallons sold	(3)	(3)	(3)	(3)	(3)	(3)
Sand and gravel—short tons	352, 905	$287, 112	317, 300	$221, 530	4 41, 659	4 $8, 486
Stone—do	5 19, 790	5 213, 351	5 11, 280	5 219, 263	5 4, 860	5 274, 130
Miscellaneous 6		2, 684, 814		2, 554, 887		2, 687, 793
Total value, eliminating duplications		612, 000		508, 000		561, 000

1 Value included with "Miscellaneous."
2 Value not included in total value for State.
3 No canvass.
4 "Government-and-contractor." Value of "Commercial" included with "Miscellaneous."
5 Exclusive of basalt in 1944 and of unclassified stone 1944–46, values for which are included with "Miscellaneous."
6 Includes minerals indicated by "1," "4" ,and "5" above.

SOUTH CAROLINA

Barite—short tons	(1)	(1)				
Clay:						
Products, heavy clay (other than pottery and refractories)		2 $1, 100, 000		2 $1, 286, 592		2 $2, 421, 000
Raw—short tons	3 140, 883	3 1, 111, 884	3 380, 769	3 1, 659, 268	3 614, 403	3 2, 795, 123
Corundum—do	(1)	(1)				
Ferro-alloys—do	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)
Gem stones		(5)		(5)		(5)
Manganese ore—short tons	1, 484	(1)	41	(1)	78	(1)
Manganiferous ore—do	171	(1)				
Mica:						
Scrap—do					(1)	(1)
Sheet—pounds			275	889		
Mineral waters—gallons sold	(5)	(5)	(5)	(5)	(5)	(5)
Sand and gravel—short tons	269, 743	190, 114	319, 933	202, 335	524, 271	214, 964
Stone—do	1, 195, 900	1, 717, 295	6 1, 380, 800	6 2, 041, 202	1, 979, 270	2, 990, 678
Topaz, industrial—do	(1)	(1)	(1)	(1)	(1)	(1)
Vermiculite—do	(1)	(1)	(1)	(1)	(1)	(1)
Miscellaneous 7		2, 736, 985		2, 314, 077		2, 853, 886
Total value, eliminating duplications		4, 192, 000		5, 043, 000		8, 189, 000

1 Value included with "Miscellaneous."
2 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945-46: Figures obtained through cooperation with Bureau of the Census.
3 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
4 Value not included in total value for State.
5 No canvass.
6 Exclusive of unclassified stone, value for which is included with "Miscellaneous."
7 Includes minerals indicated by "1" and "5" above.

Beryllium concentrates	short tons	306	$44,565	38	$5,776	95	$17,422
Cement	barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:							
Products, heavy clay (other than pottery and refractories)			(1 2)		(1 2)		(1 2)
Raw	short tons	3 169,893	3 1,104,919	3 194,929	3 1,214,132	3 247,257	3 1,428,703
Coal	do	26,827	55,000	24,445	53,000	23,000	55,000
Copper	pounds	2,000	270				
Feldspar (crude)	long tons	64,806	288,188	68,374	314,787	74,540	299,852
Gem stones			(4)		(4)		(4)
Gold	troy ounces	11,621	406,735	55,948	1,958,180	312,247	10,928,645
Gypsum (crude)	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Iron ore sold for paint	long tons	1,038	(1)	4,162	(1)		
Lead	short tons	34	5,440				
Lime	do	(1)	(1)	(1)	(1)	(1)	(1)
Lithium minerals	do	4,416	172,421	225	8,370	813	30,610
Mica:							
Scrap	do	2,558	51,405	1,192	21,534	2,806	63,692
Sheet	pounds	146,383	472,026	56,570	178,696	17,400	8,432
Mineral waters	gallons sold	(4)	(4)	(4)	(4)	(4)	(4)
Natural gas	M cubic feet	5,000	2,000	5,000	2,000	5,000	2,000
Ores (crude), etc.:							
Dry and siliceous (gold and silver)	short tons			312,612	(5)	872,242	(5)
Zinc-lead	do	2,839	(5)				
Sand and gravel	do	2,501,431	956,178	2,642,494	1,106,983	3,215,608	1,537,822
Silica (quartz)	do			(1)	(1)	(1)	(1)
Silver	troy ounces	5,445	3,872	26,564	18,890	86,901	70,216
Stone	short tons	255,530	1,412,141	6 303,500	6 1,605,904	379,880	2,385,543
Tantalum and columbium ores	pounds	(1)	(1)	(1)	(1)	1,703	3,246
Tin (metallic equivalent)	short tons	(1)	(1)				
Tungsten concentrates (60-percent WO_3 basis)	do	7	(1)	4	(1)	1	(1)
Zinc	do	56	12,768				
Miscellaneous 7			484,534		662,163		1,612,755
Total value, eliminating duplications			5,472,000		7,139,000		18,410,000

1 Value included with "Miscellaneous."
2 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
3 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
4 No canvass.
5 Not valued as ore; value of recoverable metal content included with the metals.
6 Exclusive of crushed granite and unclassified stone, values for which are included with "Miscellaneous."
7 Includes minerals indicated by "1" and "6" above.

Mineral products of the United States, 1944–46, by States—Continued

TENNESSEE

Product	1944		1945		1946	
	Quantity	Value	Quantity	Value	Quantity	Value
Aluminum short tons	[1 2]	[1 2]	[1 2]	[1 2]	[1 2]	[1 2]
Barite do	43,033	$279,567	32,812	$256,756	33,595	$272,169
Cement barrels	3,811,780	6,080,921	2,898,053	4,669,330	5,372,964	9,386,582
Clay:						
Products, heavy clay (other than pottery and refractories)		[3] 1,500,000		[3] 1,988,736		[3] 3,691,000
Raw short tons	[4] 141,417	[4] 764,016	[4] 482,107	[4] 1,196,498	[4] 893,313	[4] 1,955,408
Coal do	7,266,047	23,704,464	6,270,708	21,478,639	6,150,000	23,565,000
Coke do	228,353	[1 2]	236,979	[1 2]	229,751	[1 2]
Copper pounds	[1]	[1]	[1]	[1]	[1]	[1]
Ferro-alloys short tons	69,451	[1 2]	60,646	[1 2]	63,425	[2] 6,162,051
Fuller's earth do	[1]	[1]	[1]	[1]	[1]	[1]
Gold troy ounces	222	7,770	148	5,180	95	3,325
Iron:						
Ore (sinter from copper-iron ore) long tons	300,565	[1]	307,500	[1]	332,756	[1]
Pig short tons	[1 2]	[1 2]	[1 2]	[1 2]	32,688	[1 2]
Lead do			54	9,288	125	27,250
Lime do	193,202	1,246,802	207,587	1,373,268	160,698	1,232,480
Manganese ore do	418	[1]				
Manganiferous ore do	6,779	[1]	1,000	[1]		
Mineral waters gallons sold	[5]	[5]	[5]	[5]	[5]	[5]
Natural gas M cubic feet	10,000	5,000	10,000	5,000	30,000	15,000
Ores (crude), etc.:						
Copper short tons	1,032,525	[6]	1,013,740	[6]	1,012,910	[6]
Lead do			575	[6]	1,600	[6]
Zinc do	1,575,031	[6]	1,322,799	[6]	798,409	[6]
Petroleum barrels	9,000	[1]	8,000	[1]	10,000	[1]
Phosphate rock long tons	1,321,664	5,953,933	1,289,231	6,027,987	[1]	[1]
Pyrites do	[1]	[1]	[1]	[1]	[1]	[1]
Sand and gravel short tons	2,784,157	2,314,478	3,097,626	2,578,379	4,011,591	3,632,603
Silica (quartz) do	[1]	[1]			[1]	[1]
Silver troy ounces	45,907	32,645	35,391	25,167	18,016	14,557
Stone short tons	[7] 6,063,420	[7] 7,776,775	4,772,720	6,318,915	5,156,490	7,625,086
Sulfuric acid (60° B.) [8] do	[1 2]	[1 2]	[1 2]	[1 2]	[1 2]	[1 2]
Zinc do	40,831	9,309,468	33,824	7,779,520	24,614	6,005,816
Miscellaneous [9]		54,324,215		46,154,760		48,446,809
Total value, eliminating duplications		63,998,000		58,676,000		70,051,000

[1] Value included with "Miscellaneous."
[2] Value not included in total value for State.
[3] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[4] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included with the metals.
[7] Exclusive of crushed sandstone, value for which is included with "Miscellaneous."
[8] From copper smelting.
[9] Includes minerals indicated by "1" and "7" above.

Asphalt (native)	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Bromine	pounds	(1)	(1)	(1)	(1)	(1)	(1)
Cement	barrels	6, 261, 931	$11, 138, 156	8, 388, 159	$14, 790, 545	10, 996, 478	$19, 946, 600
Clay:							
Products, heavy clay (other than pottery and refractories)			[2] 3, 200, 000		[2] 4, 985, 138		[2] 7, 019, 000
Raw	short tons	[3] 147, 599	[3] 617, 507	[3] 846, 000	[3] 1, 443, 704	[3] 1, 369, 003	[3] 1, 714, 403
Coal	do	109, 532	95, 000	79, 949	68, 000	80, 000	68, 000
Coke	do	184, 506	([4])	140, 254	([4])		
Copper	pounds	230, 000	31, 050	110, 000	14, 850	6, 000	972
Feldspar (crude)	long tons	(1)	(1)	(1)	(1)	(1)	(1)
Fluorspar	short tons	4, 769	100, 381	3, 413	(1)	1, 118	(1)
Fuller's earth	do	111, 212	916, 159	103, 076	931, 878	110, 693	1, 157, 892
Gem stones			(5)		(5)		(5)
Gold	troy ounces					9	315
Graphite, crystalline	pounds	3, 200, 000	185, 264	(1)	(1)	(1)	(1)
Gypsum (crude)	short tons	344, 936	489, 638	407, 640	511, 869	771, 633	1, 630, 929
Helium	cubic feet	[6] 96, 884, 410	[6] 619, 345	[6] 69, 808, 454	[6] 460, 015	[6] 60, 493, 365	[6] 440, 912
Iron:							
Ore	long tons	278, 034	(1)	217, 237	705, 736	21, 458	(1)
Pig	short tons	137, 566	([4])	147, 247	([4])		
Lead	do					47	10, 246
Lime	do	94, 923	757, 141	105, 277	807, 332	121, 841	1, 053, 493
Magnesite	do	(1)	(1)	(1)	(1)	(1)	(1)
Magnesium	do	(1)	(1)	(1)	(1)	8, 498	3, 484, 000
Magnesium compounds (natural)	pounds	444, 738, 000	7, 123, 721	171, 936, 000	2, 818, 408	(1)	(1)
Mercury	flasks (76 pounds)	1, 095	129, 604	(1)	(1)		
Mineral waters	gallons sold	(5)	(5)	(5)	(5)	(5)	(5)
Natural gas	M cubic feet	1, 525, 515, 000	223, 800, 000	1, 711, 401, 000	253, 845, 000	1, 815, 000, 000	268, 620, 000
Natural gasoline and allied products:							
Natural gasoline and cycle products	gallons	1, 324, 877, 000	64, 099, 000	1, 467, 138, 000	65, 923, 000	1, 581, 451, 000	64, 169, 000
Liquefied petroleum gases	do	544, 618, 000	14, 765, 000	721, 167, 000	20, 067, 000	691, 357, 000	15, 157, 000
Ores (crude), etc.:							
Copper	short tons	3, 799	(7)	1, 600	(7)	80	(7)
Dry and siliceous (gold and silver)	do	361	(7)	1, 093	(7)	2, 054	(7)
Lead	do					221	(7)
Zinc	do					4, 350	(7)
Peat	do	(1)	(1)	(1)	(1)	(1)	(1)
Pebbles for grinding	do	(1)	(1)	(1)	(1)	177	1, 770
Petroleum	barrels	746, 699, 000	902, 660, 000	754, 710, 000	914, 410, 000	760, 505, 000	1, 063, 550, 000
Pumice	short tons	(1)	(1)	584	11, 680	805	13, 054
Salt (sodium chloride)	do	1, 147, 397	1, 353, 756	1, 100, 791	1, 336, 162	1, 098, 589	1, 356, 676
Sand and gravel	do	9, 307, 531	6, 424, 132	11, 038, 244	7, 595, 904	11, 188, 849	8, 086, 097
Silver	troy ounces	5, 355	3, 808	23, 265	16, 544	42, 922	34, 681
Soapstone	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Sodium sulfate (natural)	do	(1)	(1)	(1)	(1)	(1)	(1)
Stone	do	[8] 2, 742, 120	[8] 2, 455, 791	2, 798, 580	2, 726, 659	3, 285, 220	3, 611, 118
Strontium minerals	do	(1)	(1)	(1)	(1)		

See footnotes at end of table.

Mineral products of the United States, 1944–46, by States—Continued

TEXAS—Continued

Product		1944		1945		1946	
		Quantity	Value	Quantity	Value	Quantity	Value
Sulfur	long tons	2,874,478	$45,991,648	3,069,815	$49,117,040	3,188,086	$51,009,372
Sulfuric acid (60° B.) [9]	short tons	(14)	(14)	(14)	(14)	(14)	(14)
Sulfur ore	long tons	1,550	7,750	1,300	6,500	(1)	(1)
Tungsten concentrates (60-percent WO_3 basis)	short tons					1	(1)
Vermiculite	do					(1)	(1)
Zinc	do					44	10,736
Miscellaneous [10]			36,998,659		22,443,374		7,662,705
Total value, eliminating duplications			1,319,266,000		1,359,603,000		1,518,111,000

[1] Value included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[3] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] Value not included in total value for State.
[5] No canvass.
[6] Figure covers fiscal year ended June 30 of year stated.
[7] Not valued as ore; value of recoverable metal content included with the metals.
[8] Exclusive of basalt and dimension unclassified stone, values for which are included with "Miscellaneous."
[9] From zinc smelting.
[10] Includes minerals indicated by "1" and "8" above.

UTAH

Antimony ore (concentrates)	short tons	5	$371				
Arsenious oxide	do	(1)	(1)	(1)	(1)	(1)	(1)
Asphalt (native)	do	(1)	(1)	83,123	$1,414,422	96,974	$1,615,368
Bismuth	pounds	(2)	(2)	(2)	(2)	(2)	(2)
Bitumen, natural sulfonated	short tons	(1)	(1)				
Cement	barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:							
Products, heavy clay (other than pottery and refractories)			(13)		(13)		(13)
Raw	short tons	[4] 26,152	[4] 65,208	[4] 55,395	[4] 90,295	[4] 105,621	[4] 199,775
Coal	do	7,119,261	22,032,130	6,679,063	22,798,321	5,990,000	21,744,000
Coke	do	760,874	(15)	735,511	(15)	492,367	(15)
Copper	pounds	565,150,000	76,295,250	452,752,000	61,121,520	228,568,000	37,028,016
Fluorspar	short tons	3,466	(1)	2,973	(1)	2,370	(1)
Fuller's earth	do	(1)	(1)	(1)	(1)	(1)	(1)
Gem stones			(6)		(6)		(6)

Gold	troy ounces	344,223	12,047,805	279,979	9,799,265	178,533	6,248,655
Gypsum (crude)	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Iron:							
Ore	long tons	1,540,594	1,742,876	1,925,572	2,170,334	1,321,334	1,372,109
Pig	short tons	(1 5)	(1 5)	(1 5)	(1 5)	(1 5)	(1 5)
Lead	do	52,519	8,403,040	40,817	7,020,524	30,711	6,694,998
Lime	do	51,202	379,550	47,484	353,671	29,057	271,526
Manganese ore	do	30	(1)				
Manganiferous ore	do	32,141	(1)	5,001	(1)	7,903	(1)
Molybdenum	pounds	(1)	(1)	(1)	(1)	(1)	(1)
Natural gas	M cubic feet	6,223,000	1,535,000	6,562,000	1,685,000	4,500,000	1,170,000
Natural gasoline	gallons	924,000	50,000	867,000	52,000	856,000	51,000
Ores (crude), etc.:							
Copper	short tons	29,930,659	(7)	23,978,159	(7)	12,471,208	(7)
Dry and siliceous (gold and silver)	do	241,337	(7)	147,691	(7)	79,875	(7)
Lead	do	15,926	(7)	24,305	(7)	11,700	(7)
Lead-copper	do					1,236	(7)
Zinc	do	95,968	(7)	104,499	(7)	105,222	(7)
Zinc-lead	do	656,065	(7)	468,530	(7)	576,450	(7)
Zinc-lead-copper	do	250	(7)				
Phosphate rock	long tons					(1)	(1)
Potassium salts	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Salt (sodium chloride)	do	119,809	368,500	122,997	363,997	121,669	339,505
Sand and gravel	do	2,468,535	1,736,102	2,147,910	1,280,578	1,653,010	992,083
Silver	troy ounces	7,593,075	5,399,520	6,106,545	4,342,432	4,118,453	3,327,710
Stone	short tons	8 363,880	8 363,285	8 215,400	8 318,254	404,370	591,940
Sulfuric acid (60° B.) 9	do	(1 5)	(1 5)	(1 5)	(1 5)	(1 5)	(1 5)
Tungsten concentrates (60-percent WO_3 basis)	do	9	13,700	5	7,048	27	(1)
Vanadium	pounds	287,045	261,765	97,572	58,154	63,188	37,370
Zinc	short tons	38,994	8,890,632	33,630	7,734,900	28,292	6,903,248
Miscellaneous 10			28,633,544		28,357,793		24,794,199
Total value, eliminating duplications			149,558,000		129,314,000		96,774,000

1 Value included with "Miscellaneous."
2 Figure not available.
3 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
4 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
5 Value not included in total value for State.
6 No canvass.
7 Not valued as ore; value of recoverable metal content included with the metals.
8 Exclusive of sandstone, value for which is included with "Miscellaneous."
9 From copper smelting.
10 Includes minerals indicated by "1" and "8" above.

Mineral products of the United States, 1944–46, by States—Continued

VERMONT

Product	1944		1945		1946	
	Quantity	Value	Quantity	Value	Quantity	Value
Arsenious oxide ..... short tons	(1)	(1)	(1)	(1)		
Asbestos ..... do	(2)	(2)	(2)	(2)	(2)	(2)
Clay:						
Products, heavy clay (other than pottery and refractories)		(2 3)		(2 3)		(2 3)
Raw ..... short tons	(2 4)	(2 4)	(2 4)	(2 4)	(2 4)	(2 4)
Copper ..... pounds	3,796,000	$512,460	(2)	(2)	(2)	(2)
Gold ..... troy ounces	100	3,500	104	$3,640	165	$5,775
Lime ..... short tons	45,624	294,902	38,096	267,478	(2)	(2)
Mineral waters ..... gallons sold	(5)	(5)	(5)	(5)	(5)	(5)
Ores (crude), etc.: Copper ..... short tons	91,289	(6)	82,943	(6)	126,782	(6)
Sand and gravel ..... do	168,006	107,853	134,977	61,172	383,576	241,289
Silver ..... troy ounces	18,862	13,413	20,586	14,639	35,275	28,502
Slate		1,384,544		1,691,825		(2)
Stone ..... short tons	168,560	4,396,576	173,120	4,538,557	230,400	6,740,160
Talc ..... do	60,692	724,556	63,574	752,583	75,144	843,247
Miscellaneous [7]		234,065		923,082		4,243,652
Total value, eliminating duplications		7,672,000		8,249,000		12,096,000

[1] Figure not available.
[2] Value included with "Miscellaneous."
[3] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[4] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included with the metals.
[7] Includes minerals indicated by "2" above.

VIRGINIA

Aplite (crude) ..... long tons	(1)	(1)	(1)	(1)	(1)	(1)
Bauxite (dried equivalent) ..... do			(1)	(1)	(1)	(1)
Beryllium concentrates ..... short tons	(1)	(1)				
Cement ..... barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)		[2] $1,200,000		[2] $1,254,665		[2] $2,914,000
Raw ..... short tons	(1 3)	(1 3)	(1 3)	(1 3)	[3] 325,901	[3] 328,724
Coal ..... do	19,513,874	62,946,274	17,234,993	59,071,606	16,300,000	60,838,000
Coke ..... do	243,116	[4] 1,895,243	191,032	[4] 1,541,650	171,242	[4] 1,619,144
Copper ..... pounds	582,000	78,570	140,000	18,900		

Feldspar (crude)	long tons	24,010	147,106	29,089	178,664	32,960	204,588
Ferro-alloys	short tons	(4)	(4)	(4)	(4)	(4)	(4)
Gem stones			(5)		(5)		(5)
Gold	troy ounces	132	4,620	12	420		
Gypsum (crude)	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Iron:							
Ore	long tons	6,716	(1)	(1)	(1)	(1)	(1)
Pig	short tons	(4)	(4)	(4)	(4)	2	(4)
Kyanite	do	(1)	(1)	(1)	(1)	(1)	(1)
Lead	do	4,622	739,520	4,243	729,796	4,381	955,058
Lime	do	154,160	1,129,342	118,707	835,575	181,282	1,365,931
Manganese ore	do	20,172	623,080	8,566	307,976	1,280	(1)
Manganiferous ore	do	4,419	(1)	392	(1)	87	(1)
Marl, calcareous	do	68,707	84,207	88,936	122,135	137,122	175,389
Mica:							
Ores (crude), etc.:							
Scrap	do	1,700	38,294	376	7,720	286	6,697
Sheet	pounds	15,082	57,906	2,983	2,395		
Millstones			(1)		(1)		(1)
Mineral waters	gallons sold	(5)	(5)	(5)	(5)	(5)	(5)
Natural gas	M cubic feet	57,000	56,000	56,000	53,000	50,000	40,000
Ores (crude), etc.:							
Copper	short tons	1,926	(6)	1,047	(6)		
Zinc-lead	do	528,688	(6)	449,290	(6)	490,278	(6)
Petroleum	barrels	3,000	(1)	4,000	(1)	16,000	(1)
Phosphate rock	long tons	(1)	(1)	(1)	(1)	(1)	(1)
Pyrites	do	(1)	(1)	(1)	(1)	(1)	(1)
Quartz crystal	pounds	(7)	(7)				
Salt	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Sand and gravel	do	3,247,670	3,328,645	2,965,270	2,721,351	5,340,372	4,319,125
Sand and sandstone (ground)	do	(1)	(1)	(1)	(1)	(1)	(1)
Silica (quartz)	do	75	303	(1)	(1)		
Silver	troy ounces	18,993	13,506	1,300	924		
Slate			(1)		(1)		(1)
Stone [8]	short tons	5,539,760	6,360,769	5,445,900	6,689,809	7,873,020	9,754,482
Talc and ground soapstone [8]	do	(1)	(1)	(1)	(1)	(1)	(1)
Tantalum and columbium ore: Tantalum ore	pounds	(1)	(1)				
Titanium concentrates:							
Ilmenite	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Rutile	do	(1)	(1)	(1)	(1)	(1)	(1)
Zinc	do	19,667	4,484,076	16,075	3,697,250	16,905	4,124,820
Miscellaneous [9]			11,907,004		11,186,298		11,588,339
Total value, eliminating duplications			87,001,000		82,012,000		92,107,000

[1] Value included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[3] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] Value not included in total value for State.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included with the metals.
[7] Figure not available.
[8] Soapstone used as dimension stone included in figures for stone.
[9] Includes minerals indicated by "1" above.

Mineral products of the United States, 1944–46, by States—Continued

WASHINGTON

Product		1944		1945		1946	
		Quantity	Value	Quantity	Value	Quantity	Value
Aluminum	short tons	(1 2)	(1 2)	(1 2)	(1 2)	[3] 137, 688	[3] $38, 872, 100
Antimony ore (concentrates)	do					205	10, 040
Arsenious oxide	do	(3)	(3)	(3)	(3)	(3)	(3)
Cement	barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:							
Products, heavy clay (other than pottery and refractories)			[4] $1, 100, 000		[4] $1, 336, 877		[4] 2, 216, 000
Raw	short tons	[5] 54, 473	[5] 97, 449	[5] 183, 009	[5] 204, 837	[5] 235, 361	[5] 227, 594
Coal	do	1, 524, 141	7, 358, 966	1, 357, 244	6, 947, 404	990, 000	5, 465, 000
Copper	pounds	12, 338, 000	1, 665, 630	11, 642, 000	1, 571, 670	9, 054, 000	1, 466, 748
Diatomite	short tons	(1)	(1)	(1)	(1)	(1)	(1)
Ferro-alloys	do	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)	(1 2)
Fluorspar	do			132	(1)	38	(1)
Gem stones			(6)		(6)		(6)
Gold	troy ounces	47, 277	1, 654, 695	57, 860	2, 025, 100	51, 168	1, 790, 880
Iron ore	long tons	8, 695	(1)				
Lead	short tons	5, 825	932, 000	3, 802	653, 944	2, 987	651, 166
Lime	do	55, 241	667, 546	(1)	(1)	(1)	(1)
Magnesite	do	(1)	(1)	(1)	(1)	(1)	(1)
Magnesium	do	(1)	(1)				
Manganese ore	do	5, 199	(1)	6, 994	(1)	1, 424	(1)
Mineral waters	gallons sold	(6)	(6)	(6)	(6)	(6)	(6)
Olivine	short tons					1, 400	(1)
Ores (crude), etc.:							
Copper	do	36	(7)	38	(7)	43	(7)
Dry and siliceous (gold and silver)	do	62, 063	(7)	53, 174	(7)	51, 622	(7)
Lead	do	477	(7)	1, 800	(7)	6, 920	(7)
Zinc	do	31, 908	(7)	29, 607	(7)	39, 634	(7)
Zinc-copper	do	756, 081	(7)	617, 120	(7)	491, 402	(7)
Zinc-lead	do	330, 097	(7)	266, 507	(7)	268, 402	(7)
Peat	do	(1)	(1)	824	903	(1)	(1)
Pebbles for grinding	do	(1)	(1)	(1)	(1)	21	210
Pulpstones	do					72	3, 880
Pumice	do	783	8, 705	4, 414	36, 045	14, 585	56, 008
Quartz crystal	pounds	(3)	(3)				
Sand and gravel	short tons	6, 946, 153	4, 076, 976	6, 949, 809	3, 872, 633	7, 557, 707	4, 608, 392
Sand and sandstone (ground)	do	(1)	(1)	(1)	(1)	(1)	(1)
Silica (quartz)	do	(1)	(1)	(1)	(1)	(1)	(1)
Silver	troy ounces	321, 608	228, 699	281, 444	200, 138	264, 453	213, 678
Stone	short tons	[8] 2, 538, 690	[8] 2, 756, 332	[8] 3, 741, 250	[8] 3, 773, 096	[8] 3, 149, 900	[8] 3, 232, 805
Talc and ground soapstone	do	3, 288	34, 103	2, 804	33, 458	5, 084	38, 051

Tungsten concentrates (60-percent WO_3 basis)	do	5	(1)	2	(1)	1	(1)
Zinc	do	11,904	2,714,112	11,693	2,689,390	11,329	2,764,276
Miscellaneous [9]			82,245,103		59,736,000		11,812,187
Total value, eliminating duplications			36,483,000		31,301,000		33,076,000

[1] Value included with "Miscellaneous."
[2] Value not included in total value for State.
[3] Figure not available.
[4] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[5] 1944, sold or shipped 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[6] No canvass.
[7] Not valued as ore; value of recoverable metal content included with the metals.
[8] Exclusive of marble, 1944–45 and sandstone in 1946, values for which are included with "Miscellaneous."
[9] Includes minerals indicated by "1" and "8" above.

WEST VIRGINIA

Bromine	pounds	(1)	(1)	(1)	(1)	(1)	(1)
Calcium chloride	short tons	16,256	$52,506	(1)	(1)	(1)	(1)
Cement	barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:							
Products, heavy clay (other than pottery and refractories)			[2] 1,000,000		[2] $1,141,517		[2] $4,428,000
Raw	short tons	[3] 68,898	[3] 134,312	[3] 348,080	[3] 1,003,868	[3] 469,024	[3] 992,673
Coal	do	164,703,770	495,310,654	152,034,732	486,183,764	142,060,000	520,349,000
Coke	do	3,016,548	[4] 14,255,640	2,750,331	[4] 14,167,585	2,383,050	[4] 14,104,420
Ferro-alloys	do	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)	(1 4)
Grindstones and pulpstones	do	(1)	(1)	(1)	(1)	751	23,422
Iron, pig	do	1,355,784	(1 4)	1,265,346	(1 4)	1,011,753	(1 4)
Lime	do	493,724	3,464,019	511,509	3,620,401	409,952	3,103,183
Marl, calcareous	do	(1)	(1)	(1)	(1)	(1)	(1)
Mineral waters	gallons sold	(5)	(5)	(5)	(5)	(5)	(5)
Natural gas	M cubic feet	181,452,000	74,743,000	160,225,000	67,665,000	180,000,000	76,500,000
Natural gasoline and allied products:							
Natural gasoline	gallons	57,298,000	3,210,000	53,242,000	2,766,000	60,815,000	2,364,000
Liquefied petroleum gases	do	31,619,000	1,335,000	34,367,000	1,173,000	39,311,000	1,636,000
Petroleum	barrels	3,070,000	8,910,000	2,879,000	9,620,000	2,929,000	9,880,000
Salt	short tons	359,217	1,027,109	370,260	903,759	272,841	896,894
Sand and gravel	do	2,677,752	3,624,179	2,501,773	3,323,289	3,457,372	4,518,325
Sand and sandstone (ground)	do	(1)	(1)	(1)	(1)	(1)	(1)
Stone	do	3,455,450	3,718,735	3,670,700	3,989,534	[6] 4,131,540	[6] 4,464,048
Sulfuric acid (60° B.) [7]	do	(1 4)	(1 4)	(1 4)	(1 4)		
Miscellaneous [8]			50,539,655		48,370,142		55,429,224
Total value, eliminating duplications			598,425,000		582,990,000		632,654,000

[1] Value included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[3] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] Value not included in total value for State.
[5] No canvass.
[6] Exclusive of dimension sandstone, value for which is included with "Miscellaneous."
[7] From zinc smelting.
[8] Includes minerals indicated by "1" and "6" above.

Mineral products of the United States, 1944–46, by States—Continued

WISCONSIN

Product		1944		1945		1946	
		Quantity	Value	Quantity	Value	Quantity	Value
Cement	barrels	[1]	[1]	[1]	[1]	[1]	[1]
Clay:							
Products, heavy clay (other than pottery and refractories)			[2] $130,000		[2] $172,132		[2] $408,000
Raw	short tons	[1]	[1]	[3] 61,071	[3] 46,734	[3] 154,913	[3] 135,207
Coke	do	[1 4]	[1 4]	[1 4]	[1 4]	[1 4]	[1 4]
Flint lining for tube mills	do	[1]	[1]	[1]	[1]	[1]	[1]
Iron ore	long tons	1,536,737	4,190,380	1,295,647	3,575,133	1,097,471	[1]
Lead	short tons	1,415	226,400	1,776	305,472	1,588	346,184
Lime	do	138,750	1,030,322	124,560	988,422	74,686	760,432
Marl, calcareous	do	22,416	8,410	811	801	883	750
Mineral waters	gallons sold	[5]	[5]	[5]	[5]	[5]	[5]
Ores (crude), etc.:							
Zinc	short tons	298,693	[6]	703,415	[6]	670,210	[6]
Zinc-lead	do	325,118	[6]	254,262	[6]	196,574	[6]
Peat	do	[1]	[1]	[1]	[1]	[1]	[1]
Pebbles for grinding	do	[1]	[1]	[1]	[1]	[1]	[1]
Pyrites	long tons	[1]	[1]	[1]	[1]	[1]	[1]
Sand and gravel	short tons	8,634,769	4,128,434	8,384,279	4,111,282	14,828,713	6,802,828
Sand and sandstone (ground)	do	[1]	[1]	[1]	[1]	[1]	[1]
Silica (quartz)	do	[1]	[1]	[1]	[1]	[1]	[1]
Stone	do	[7] 4,658,620	[7] 7,741,499	4,764,180	8,442,921	6,193,400	11,473,119
Zinc	do	15,549	3,545,172	15,561	3,579,030	14,276	3,483,344
Miscellaneous [8]			7,959,755		7,249,262		12,263,081
Total value, eliminating duplications			22,798,000		22,217,000		28,596,000

[1] Value included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–46: Figures obtained through cooperation with Bureau of the Census.
[3] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] Value not included in total value for State.
[5] No canvass.
[6] Not valued as ore; value of recoverable metal content included with the metals.
[7] Exclusive of basalt, value for which is included with "Miscellaneous."
[8] Includes minerals indicated by "[1]" and "[7]" above.

WYOMING

Cement—barrels	(1)	(1)	(1)	(1)	(1)	(1)
Clay:						
Products, heavy clay (other than pottery and refractories)		(1 2)		(1 2)		2 $268,000
Raw—short tons	3 196,138	3 $1,711,193	3 206,535	3 $1,694,154	3 232,835	3 2,003,537
Coal—do	9,540,012	25,636,793	9,847,575	27,840,341	7,805,000	23,103,000
Copper—pounds					2,000	324
Feldspar (crude)—long tons	22,415	81,770	17,021	62,614	20,345	83,496
Fluorspar—short tons	19	400				
Gem stones		(4)		(4)		(4)
Gold—troy ounces	20	700	2	70	105	3,675
Gypsum (crude)—short tons	(1)	(1)	(1)	(1)	(1)	(1)
Iron ore—long tons	713,759	(1)	606,005	(1)	619,317	(1)
Lead—short tons			3	516		
Mica:						
Scrap—do	(1)	(1)	(1)	(1)		
Sheet—pounds			(1)	(1)		
Mineral waters—gallons sold	(4)	(4)	(4)	(4)	(4)	(4)
Natural gas—M cubic feet	34,521,000	7,487,000	35,282,000	7,896,000	35,000,000	7,875,000
Natural gasoline and allied products:						
Natural gasoline—gallons	33,181,000	1,962,000	34,355,000	2,079,000	34,475,000	2,075,000
Liquefied petroleum gases—do	15,699,000	710,000	17,269,000	802,000	7,799,000	325,000
Ores (crude), etc.:						
Copper—short tons					19	(5)
Dry and siliceous (gold and silver)—do	6	(5)	37	(5)	42	(5)
Lead—do			15	(5)		
Petroleum—barrels	33,356,000	33,290,000	36,219,000	36,610,000	38,304,000	46,000,000
Sand and gravel—short tons	1,460,663	720,381	1,541,369	693,239	2,005,951	1,129,598
Silver—troy ounces	3	2	31	22	26	21
Sodium sulfate (natural)—short tons	(1)	(1)	(1)	(1)	(1)	(1)
Stone—do	396,660	383,463	1,551,220	1,321,415	1,204,570	1,203,636
Vermiculite—do	(1)	(1)	(1)	(1)	(1)	(1)
Miscellaneous 6		2,191,358		2,126,625		3,001,393
Total value, eliminating duplications		74,175,000		81,101,000		87,057,000

[1] Value included with "Miscellaneous."
[2] 1944: Estimate by Bureau of Mines based on figures issued by Bureau of the Census covering certain classes of clay products; 1945–1946: Figures obtained through cooperation with Bureau of the Census.
[3] 1944, sold or shipped. 1945–46, sold or used; value of clay used in cement and heavy clay products not included in total value for State.
[4] No canvass.
[5] Not valued as ore; value of recoverable metal content included with the metals.
[6] Includes minerals indicated by "1" above.

793095—48——9

Employment and Injuries
in the Mineral Industries

By FORREST T. MOYER

	PAGE		PAGE
General summary	74	Quarries	85
Coal mines	79	Coke plants	88
Metal mines	82	Metallurgical plants	89
Nonmetal mines	85		

GENERAL SUMMARY

LABOR supply in the mineral industries was no longer a serious problem in 1946, and the average number of men working daily increased to 674,700. The labor shortage, which had become progressively more acute in the extractive industries throughout the war years, apparently was eased rapidly after the downtrend in employment was reversed shortly after the end of the war in the latter part of 1945. However, labor-management relations in 1946 were unsettled and widespread, and extended work stoppages occurred in several important segments of the mineral industries. In addition, strikes in certain mineral-consuming industries had pronounced adverse effects on employment in some of the extractive industries. As a result, total worktime dropped to about 1⅓ billion man-hours in 1946 or 7 percent below 1945. Total man-hour data on the mineral industries for 1931–43 are revised in this chapter to include estimated time required for travel and lunch in bituminous-coal mines.

The safety record of the extractive industries receded in 1946, and the over-all frequency of injuries increased from 52.59 per million man-hours of work in 1945 to 55.43 in 1946. Fatality experience

Salient statistics of employment and injury experience in the mineral industries in the United States, 1942–46, by mineral industry groups

	1942	1943	1944	1945	1946 [1]
Average number of men working daily: [2]					
Coal mines	530,861	486,516	453,937	[3] 437,000	457,500
Metal mines	99,769	88,039	70,480	61,470	65,500
Nonmetal mines	12,677	12,713	11,261	10,371	12,000
Quarries	84,270	69,877	58,476	58,180	73,500
Coke plants	23,909	25,765	24,766	22,987	21,500
Metallurgical plants	51,154	64,735	58,085	46,467	44,700
Total	802,640	747,645	677,005	636,475	674,700
Average number of active mine-days: [4]					
Coal mines	243	264	281	[3] 262	230
Metal mines	280	294	289	288	248
Nonmetal mines	274	269	282	291	287
Quarries	271	274	268	264	270
Coke plants	346	347	351	344	335
Metallurgical plants	334	336	329	329	285
Total	260	277	287	273	244

See footnotes at end of table.

Salient statistics of employment and injury experience in the mineral industries in the United States, 1942–46, by mineral industry groups—Continued

	1942	1943	1944	1945	1946 [1]
Man-days worked, in thousands: [5]					
Coal mines	129,136	128,297	127,510	[3] 114,500	105,100
Metal mines	27,968	25,848	20,366	17,728	16,233
Nonmetal mines	3,473	3,426	3,173	3,016	3,441
Quarries	22,808	19,136	15,691	15,376	19,857
Coke plants	8,282	8,947	8,687	7,915	7,203
Metallurgical plants	17,073	21,755	19,113	15,268	12,760
Total	208,740	207,409	194,540	173,803	164,594
Man-hours worked, in thousands: [5]					
Coal mines [6]	1,021,043	1,034,507	1,078,474	[3] 984,000	884,000
Metal mines	223,093	206,704	163,169	141,734	131,010
Nonmetal mines	28,094	27,999	25,760	24,613	27,480
Quarries	180,836	155,280	129,302	127,168	162,330
Coke plants	65,222	70,679	69,590	64,375	57,900
Metallurgical plants	134,997	173,633	152,326	121,491	100,990
Total [6]	1,653,285	1,668,802	1,618,621	1,463,381	1,363,710
Number of injuries:					
Fatal:					
Coal mines	1,471	1,451	1,298	[3] 1,079	974
Metal mines	215	195	130	96	86
Nonmetal mines	22	25	17	16	24
Quarries	112	80	73	53	50
Coke plants	13	17	15	18	8
Metallurgical plants	29	31	38	19	19
Total	1,862	1,799	1,571	1,281	1,161
Nonfatal:					
Coal mines	[7] 66,774	64,594	63,691	[3] 59,350	56,800
Metal mines	12,420	11,554	8,909	6,945	7,195
Nonmetal mines	1,537	1,471	1,283	1,145	1,390
Quarries	6,349	5,199	4,437	4,121	5,375
Coke plants	921	986	988	835	855
Metallurgical plants	3,674	4,666	4,158	3,271	2,810
Total	91,675	88,470	83,466	75,667	74,425
Injury rates per million man-hours:					
Fatal:					
Coal mines	1.44	1.40	1.20	[3] 1.10	1.10
Metal mines	.96	.94	.80	.68	.66
Nonmetal mines	.78	.89	.66	.65	.87
Quarries	.62	.52	.56	.42	.31
Coke plants	.20	.24	.22	.28	.14
Metallurgical plants	.21	.18	.25	.16	.19
Total	1.13	1.08	.97	.88	.85
Nonfatal:					
Coal mines	65.40	62.44	59.06	[3] 60.32	64.25
Metal mines	55.67	55.90	54.60	49.00	54.92
Nonmetal mines	54.71	52.54	49.81	46.52	50.58
Quarries	35.11	33.48	34.32	32.41	33.11
Coke plants	14.12	13.95	14.20	12.97	14.77
Metallurgical plants	27.22	26.87	27.30	26.92	27.82
Total	55.45	53.01	51.57	51.71	54.58

[1] Preliminary figures based on average of 83 percent coverage.
[2] Average number of men at work each day mine was active. Because absenteeism and labor turn-over are taken into consideration, this number is lower than number of men available for work as measured by a count of names on pay roll.
[3] Preliminary figure based upon 75 percent coverage of the industry.
[4] Average in which operating time of each mine is weighted by average number of workers in mine.
[5] Totals of man-days and man-hours are additions of the rounded subtotals and may differ slightly from totals obtained before rounding.
[6] Data included for bituminous-coal mines are on portal-to-portal basis. See accompanying table "Employment and injury experience at bituminous-coal mines in the United States, 1930–46, on working time and portal-to-portal bases."
[7] Data included for anthracite mines are revised.

was improved in 1946, and both the total of 1,161 fatalities and the rate of 0.85 per million man-hours were lower than in 1945. The number of nonfatal injuries—74,425—was lower than in 1945; but, owing to the reduced worktime, these injuries occurred at a rate of 54.58 per million man-hours compared with 51.71 in 1945.

A principal factor in the retrogression of mine safety during 1946 was incomplete training in safe job methods for the experienced men shifted into new occupations and for the new and inexperienced workers hired as the labor force was expanded. An analysis of 2,547 detailed descriptions of injuries in 26 scattered coal mines in 1946 reveals that 588 injuries happened to men with 6 months or less experience in the mining occupation at which they were injured. These 588 injuries comprised 5 fatal and 583 nonfatal cases, which were, respectively, 15 and 23 percent of the 34 fatal and 2,513 nonfatal injuries comprising the total sample. The imperative need for training in safe work-procedures also was emphasized by the experience of the portland-cement industry, which has an outstanding record in accident prevention. Classification of 10 fatal- and 456 nonfatal-injury descriptions [1] in cement quarries and plants during 1946 shows that 7 of the fatalities and 217 of the nonfatal injuries involved men with 6 months or less experience in the occupation at which they were injured. The higher proportion of injuries (48 percent) to inexperienced men in the cement industry compared with the corresponding 23 percent in coal mining may be correlated with the difference in expansion of the labor force in 1946. In cement, the number of workers increased 24 percent, whereas the gain in coal was only 5 percent.

Labor-management relations in the conversion from wartime to peacetime operating and working conditions floundered throughout 1946. Disputes centering principally on questions of wages and hours of work resulted in 566 work stoppages in the mining and quarrying industries and 134 in the nonferrous smelting, refining, and alloying industries, according to the United States Department of Labor. In mining and quarrying the strikes caused a loss of 21,417,900 man-days of work, and in nonferrous smelters and refineries the loss was 4,280,000 man-days. As in 1945, most of the stoppages and loss of time during 1946 were in the coal industries. In bituminous-coal mines, 485 strikes caused a loss of 19,500,000 man-days of work, and in anthracite mines 34 stoppages caused 649,000 man-days of idleness. The total of 1,190,000 man-days of work lost in 18 work-stoppages in metal mines affected principally the Lake Superior iron-mining district and the copper mines in the Western States. There were two major strikes in bituminous-coal mines. In the first, which began April 1, labor and management could not reach agreement, and the Federal Government entered the controversy by seizing the struck mines on May 22. Mine safety was a first consideration in the negotiations of this dispute from its start. The Government-union agreement reached on May 29 provided, among other stipulations, for a Federal mine safety code and a health and welfare fund financed by a 5-cent royalty on each ton produced for use or sale. Government operation of the mines continued through 1946. The

[1] Portland Cement Association, Accident Round Table, 1946.

second bituminous-coal strike began November 21 and was ended December 7 by the union on instructions contained in an injunction obtained by the Government. An industry-wide stoppage of 8 days duration in anthracite mines was ended early in June by a labor-management agreement which contained provisions for a Federal mine safety code and a health and welfare fund supported by a 5-cent royalty on each ton produced for use or sale.

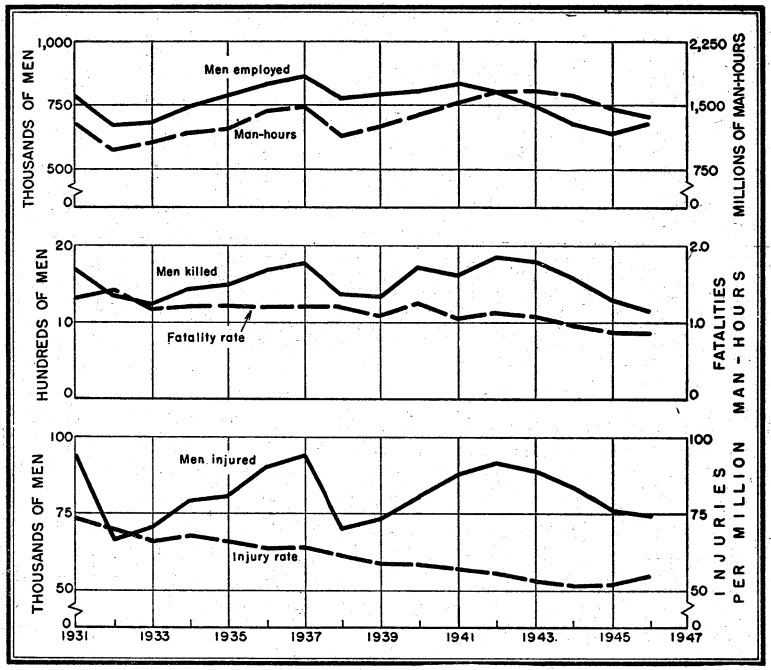

FIGURE 1.—Trends in employment and injury experience in the mineral industries of the United States, 1931–46.

The average number of men working in 1946 was higher in all major branches of the mineral industries but coke and metallurgical plants. However, the totals of man-days and man-hours of work were well below 1945 in each of these segments with the exception of nonmetal mines and quarries. The 7-percent drop in total worktime in the mineral industries resulted from declines in coal and metal mines and coke and metallurgical plants, each of which was affected seriously by work stoppages. No strikes were reported at coke plants in 1946, but the coal and steel strikes had adverse effects upon worktime at the coke operations. Man-hours of work were higher than in 1945 in nonmetal mines and the quarry industries only. Operating activity in each of the quarry industries, as measured by man-hours of work, increased sharply in 1946, owing primarily to the revived demand for quarry products in the construction industry, which recovered from its wartime slump.

The average employee in the extractive industries worked only 244 days in 1946 or 29 less than in 1945. The average length of shift

Employment and injury experience of the mineral industries of the United States, 1931–46

Year	Men working daily	Average active days	Man-days worked	Man-hours worked [1]	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal [2]	Fatal [3]	Nonfatal [3]
1931	784,347	188	147,602,799	1,288,135,808	1,707	94,021	1.33	72.99
1932	671,343	165	110,655,616	962,924,915	1,368	66,028	1.42	68.57
1933	677,722	181	122,787,658	1,058,245,650	1,242	70,158	1.17	66.30
1934	739,817	195	144,566,133	1,167,723,543	1,429	79,211	1.22	67.83
1935	783,139	195	152,354,170	1,215,316,764	1,495	80,070	1.23	65.88
1936	824,514	216	177,920,334	1,426,233,543	1,686	90,608	1.18	63.53
1937	859,951	217	186,790,283	1,482,241,908	1,759	94,466	1.19	63.73
1938	774,894	187	145,056,875	1,144,137,296	1,369	69,940	1.20	61.13
1939	788,925	202	159,388,490	1,251,169,210	1,334	73,253	1.07	58.55
1940	801,926	219	175,663,792	1,385,128,234	1,716	80,856	1.24	58.37
1941	835,095	234	195,425,228	1,541,335,277	1,621	87,911	1.05	57.04
1942	802,640	260	208,739,906	1,653,284,620	1,862	91,675	1.13	55.45
1943	747,645	277	207,408,392	1,668,802,386	1,799	88,470	1.08	53.01
1944	677,005	287	194,540,988	1,618,621,674	1,571	83,466	.97	51.57
1945 [4]	636,475	273	173,803,484	1,463,380,986	1,281	75,667	.88	51.71
1946 [5]	674,700	244	164,594,000	1,363,710,000	1,161	74,425	.85	54.58

[1] Data for 1931–43 are revised by including estimated time required for travel and lunch in bituminous coal mines. This places man-hours of bituminous-coal mines on a portal-to-portal basis.
[2] Data for 1931–42 are revised by changes that affected only the Pennsylvania anthracite industry. See Injury Experience, Exposure-to-Hazard, and Productivity at Coal Mines in the United States in 1943 Bureau of Mines H. S. S. 353, June 19, 1946, pp. 5 and 14.
[3] Revised for 1931–43 as affected by changes in man-hours and nonfatal injuries.
[4] Preliminary in part.
[5] Preliminary.

was 8.29 hours compared with 8.42 in 1945, and the worktime per man-year totaled 2,021 man-hours or 278 less than in 1945. The decline in worktime in the mineral industries in 1946 is traceable directly to the work stoppages during the year.

The total of 1,161 fatal injuries in 1946 was lower than in any other year since complete fatality statistics in the mineral industries first were compiled in 1911. The number of fatalities was reduced from 1945 in coal mines, metal mines, quarries, and coke plants; was unchanged in metallurgical plants; and was higher only in nonmetal mines. However, owing to the sharp reductions in man-hours of work, fatality experience in 1946, as measured by the frequency rate, was improved over 1945 only in the metal-mining, quarrying, and coking industries. In coal mines the rate of occurrence of fatalities was unchanged from 1945, and in nonmetal mines and metallurgical plants the frequency was less favorable.

Nonfatal-injury experience receded in 1946 and the frequency of occurrence of these injuries was higher than in 1945 in each of the mineral industries. Although the number of nonfatal injuries was reduced from 1945 in coal mining and in metallurgical plants, the rate of occurrence per million man-hours of work in these groups was higher in 1946 owing to the lower total work-time. In other groups of the extractive industries, both the number of nonfatalities and the frequency of occurrence were higher in 1946 than in 1945.

There were 2 major disasters—those in which 5 or more lives were lost in a single accident—in the mineral industries in 1946. Both major disasters were coal-mine explosions, which caused a total loss of 27 lives. In 1945, there were 5 disasters, all in coal mines, in which 68 men were killed.

COAL MINES

Fewer men were killed in coal mines in 1946 than in any other year since complete fatality statistics first were compiled in 1910. The 1946 total of 974 represented 105 fewer fatalities than in 1945 and was appreciably below the 1,064 fatal injuries in the depression year 1933, which had the next lowest annual total in statistical coal history. The frequency of occurrence remained unchanged from 1945 at 1.10 per million man-hours in 1946, owing to the reduction in total worktime. On a tonnage basis, the fatalities occurred at a rate of 1.64 per million tons of coal mined compared with 1.71 in 1945. The number of nonfatal injuries was reduced by 2,550 to a 1946 total of 56,800. These injuries occurred at rates of 64.25 per million man-hours and 95.90 per million tons compared with corresponding rates of 60.32 and 93.87 in 1945. Employment gained in 1946, but man-days and man-hours of work were appreciably lower than in 1945 owing to work stoppages. Coal mines were active an average of 230 days or 32 less than in 1945. The average length of shift was 8.41 hours, and the total worktime per man-year was 1,932 hours or 320 less than in 1945.

BITUMINOUS COAL

Employment.—The average number of men working daily in bituminous-coal mines advanced to 380,000, a 5-percent gain over 1945. Results of a monthly canvass of bituminous-coal operations showed an irregular month-to-month uptrend (in months of no strikes) in employment from 372,000 in January to 381,000 in June. During April, when the industry was nearly shut down, the average number of men working daily fell to 62,000, and many of these men were performing only maintenance or supervisory work. During the 2-week

Employment and injury experience at coal mines in the United States, 1942–46[1]

	Men working daily	Average active mine-days	Man-days worked	Man-hours worked	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-Fatal	Fatal	Non-fatal
Bituminous-coal mines:[2]								
1942	448,797	244	109,491,371	[3] 883,483,050	1,245	53,193	[3] 1.41	[3] 60.21
1943	407,135	263	106,911,764	[3] 883,675,272	1,225	51,067	[3] 1.39	[3] 57.79
1944	376,203	278	104,705,401	[3] 914,925,290	1,124	51,253	[3] 1.23	[3] 56.02
1945	363.000	261	94,750,000	[3] 841,000,000	936	47,750	[3] 1.11	[3] 56.78
1946	380,000	221	83,900,000	[3] 730,000,000	800	44,000	[3] 1.10	[3] 60.27
Pennsylvania anthracite mines:								
1942	82,064	239	19,644,236	137,559,994	226	[4] 13,581	1.64	[4] 98.73
1943	79,381	269	21,384,900	150,832,008	226	13,527	1.50	89.68
1944	77,734	293	22,804,917	163,549,087	174	12,438	1.06	76.05
1945	74,000	267	19,750,000	143,000,000	143	11,600	1.00	81.12
1946	77,500	274	21,200,000	154,000,000	174	12,800	1.13	83.12
Total coal mines:								
1942	530,861	243	129,135,607	[3] 1,021,043,044	1,471	66,774	[3] 1.44	[3] 65.40
1943	486,516	264	128,296,664	[3] 1,034,507,280	1,451	64,594	[3] 1.40	[3] 62.44
1944	453,937	281	127,510,318	[3] 1,078,474,377	1,298	63,691	[3] 1.20	[3] 59.06
1945	437,000	262	114,500,000	[3] 984,000,000	1,079	59,350	[3] 1.10	[3] 60.32
1946	457,500	230	105,100,000	[3] 884,000,000	974	56,800	[3] 1.10	[3] 64.25

[1] Data for 1945 and 1946 are preliminary.
[2] Includes lignite.
[3] Data for bituminous-coal mines are on portal-to-portal basis.
[4] Revised.

truce period in mid-May, the mines had approximately a normal working force in all States except Pennsylvania, where relatively few of the striking miners returned to work. As a result, the number of men working in the industry was only 299,000 men during May. The level of employment held at approximately 380,000 from June through September and increased through October to a November total of 385,000 men. In December the average declined to 382,000 men, owing probably to absenteeism over the holidays. Because of the widespread strikes in the spring and early winter of 1946, the mines were active an average of only 221 days, or 40 less than in 1945. Hence, despite the enlarged labor force, total worktime (on a portal-to-portal basis) dropped to 730 million man-hours or 13 percent below 1945 and production declined to a total of 532 million tons in 1946. The average miner worked an average shift of 8.70 hours (on portal-to-portal basis) and had a total work-year of only 1,921 man-hours—396 hours lower than in 1945.

Injuries.—In all, 800 men were killed at work in bituminous-coal mines in 1946, the lowest number in any year since complete fatality statistics were begun in 1910. This was 136 fewer fatal injuries than in 1945 and 33 less than in 1933, when the next lowest number of men lost their lives. The 1946 fatalities occurred at rates of 1.10 per million man-hours and 1.50 per million tons of coal mined, both of which were the lowest in the statistical history of the industry. Comparable frequencies in 1945 were 1.11 per million man-hours and 1.62 per million tons. The tonnage rate in 1946 was the lowest in a history extending back to 1874.

The total of 44,000 nonfatal injuries was 3,750 less than in 1945, but as worktime was sharply lower in 1946 these injuries occurred at a rate of 60.27 per million man-hours compared with 56.78 in 1945. As pointed out in the General Summary, incomplete training of new employees and of experienced workers transferred into new occupations as the labor force was expanded was an important factor in the unfavorable injury experience. The tonnage rate of nonfatal injuries in 1946 was 82.71 per million tons and in 1945 was 82.67.

Two major disasters, both mine explosions, occurred in 1946 and caused a loss of 27 lives. The first explosion was on January 15 in a West Virginia mine and killed 15 men. The second was on April 18 in a semianthracite mine in Virginia and killed 12 men. The loss of life in major disasters in 1946 was the third lowest in the statistical series on coal-mine accidents, and lower totals were recorded only in 1933 and 1934—respectively 7 and 22.

Of the total fatalities, 734 occurred in underground workings, 44 in surface works associated with deep mines, and 22 in strippings. In underground workings, falls of roof and face caused 445 fatalities, haulage 164, explosions (major and local) 30, machinery 27, and electricity 24 fatal injuries.

Conversion to Portal-to-Portal Base.—Man-hour data on bituminous-coal mines for 1930–46 are converted from a working time to a portal-to-portal basis for the first time in this chapter. In the 1943 wage agreement, which became generally effective in November 1943, the portal-to-portal length of shift for underground workers was made 9 hours, of which 8¾ hours was paid time (actual work or face time

plus travel time plus 15 minutes of lunch time staggered so as not to interfere with production) and ¼ hour was lunch time for which no pay was received. The April 1945 wage contract made total portal-to-portal time (a 9-hour shift) the pay basis for underground men by eliminating lunch time through staggering it so as not to interfere with production. Bituminous-coal producers in 1944 reported data on man-hours of exposure, average travel time, and lunch time to the Accident Analysis Division, Bureau of Mines. Consideration of all reported data permitted an accurate determination of working or face time and portal-to-portal time for underground employees in each mine. These data yielded an average of 1.0033 hours per man-day as the time spent for travel and lunch by underground employees in the industry in 1944. However, in 1944 most bituminous-coal mines had only ¼ hour of lunch time for which no pay was given, whereas in 1943 and earlier years nearly all mines had one-half hour for lunch without pay. Hence the conversion factor of 1.0033 per man-day underground in 1944 was increased by one-quarter hour to reach a factor of 1.2533 hours per man-day of underground work in 1943 and earlier years. The factor 1.2533 was applied without change to the reported underground man-days of work for each year back to 1930. The resulting man-hours required for travel and lunch were added to the company-reported data on man-hours at the face to obtain an estimated man-hour total on a portal-to-portal basis for each year. The conversion from working time to portal-to-portal time is not projected beyond 1930, as this was the first year for which coal producers reported man-hours of exposure for accident-statistics data.

Data in the accompanying table show total man-hours of exposure for the bituminous-coal industry on both working-time and portal-to-portal bases. The differences in the injury rates, which also are shown on the two bases, are noteworthy. The conversion to portal-to-

Employment and injury experience at bituminous-coal mines in the United States, 1930–46, on working-time and portal-to-portal bases

Year	Men working daily	Man-days worked	Man-hours worked		Number of injuries		Injury rates per million man-hours			
			Working time	Portal-to-portal	Fatal	Non-fatal	Working time		Portal-to-portal	
							Fatal	Non-fatal	Fatal	Non-fatal
1930	493,202	92,325,875	750,149,205	850,326,612	1,619	71,217	2.16	94.94	1.90	83.75
1931	450,274	73,349,461	595,979,561	674,845,333	1,080	53,975	1.81	90.57	1.60	79.98
1932	406,380	59,259,624	479,447,331	542,160,523	958	39,352	2.00	82.08	1.77	72.58
1933	418,752	69,881,999	564,425,166	638,100,656	833	43,946	1.48	77.86	1.31	68.87
1934	458,044	81,647,939	591,058,597	677,087,424	958	46,982	1.62	79.49	1.41	69.39
1935	462,354	82,291,724	578,511,200	665,019,499	968	47,529	1.67	82.16	1.46	71.47
1936	482,500	95,261,754	669,900,536	769,787,050	1,098	50,514	1.64	75.41	1.43	65.62
1937	490,771	96,130,313	675,568,195	776,548,688	1,198	52,847	1.77	78.23	1.54	68.05
1938	445,246	71,747,050	505,316,161	579,723,732	880	36,794	1.74	72.81	1.52	63.47
1939	445,044	78,966,259	554,984,350	636,802,063	867	38,544	1.56	69.45	1.36	60.53
1940	440,847	88,770,852	625,973,555	717,970,096	1,204	43,994	1.92	70.28	1.68	61.28
1941	457,744	97,999,557	691,049,388	791,396,491	1,072	46,637	1.55	67.49	1.35	58.93
1942	448,797	109,491,371	772,828,992	883,483,050	1,245	53,193	1.61	68.83	1.41	60.21
1943	407,135	106,911,764	777,970,318	883,675,272	1,225	51,067	1.57	65.64	1.39	57.79
1944	376,203	104,705,401	833,770,709	914,925,290	1,124	51,253	1.35	61.47	1.23	56.02
1945 [1]	363,000	94,750,000	762,000,000	841,000,000	936	47,750	1.23	62.66	1.11	56.78
1946 [1]	380,000	83,900,000	670,000,000	730,000,000	800	44,000	1.19	65.67	1.10	60.27

[1] Preliminary data

portal time results in average reductions of 12 percent in both the fatal- and nonfatal-injury rates from 1930 through 1943. In 1944 the differences in the rates were 9 percent or a reduction of smaller proportions than in earlier years owing to the differences between lunch times in 1944 and earlier years for which no pay was received.

Injuries to underground men while traveling in or out of the mine or while eating lunch always have been reported by the producers to the Bureau of Mines. Combination of this count of injuries with the portal-to-portal man-hours yields true injury-frequency rates for bituminous-coal mines.

Inasmuch as the bituminous-coal industry represents a large proportion of the total mineral industry, conversion to a portal-to-portal base has an appreciable effect on the over-all man-hour and injury rates for mineral industries. The revised aggregate data on mineral industries are listed in the second table in the General Summary.

ANTHRACITE

Employment.—Employment at anthracite operations gained 5 percent over 1945 to a total of 77,500 men in 1946. Despite an 8-day work stoppage at the end of May and the beginning of June, the anthracite operations were worked an average of 274 days, or 7 more than in 1945. As a result, the enlarged labor force worked 154 million man-hours in 1946, or 8 percent above the 1945 worktime. Production from underground mines, strippings, culm banks, and dredges increased to 60,282,000 tons. This tonnage excludes "bootleg" coal purchased and prepared by recognized producers. The average employee in 1946 worked a 7.26-hour shift and performed 1,987 man-hours of work, or 55 hours more than in 1945.

Injuries.—Injury experience at anthracite operations was less favorable in 1946 than in 1945, and both the numbers and frequencies of fatal and nonfatal injuries were higher. The 174 fatalities occurred at frequency rates of 1.13 per million man-hours and 2.89 per million tons of clean coal in 1946; whereas the respective rates were 1.00 and 2.62 for the 143 fatalities in 1945. The total of 12,800 nonfatal injuries in 1946 had frequencies of 83.12 per million man-hours and 212.34 per million tons compared with a total of 11,600 injuries at corresponding rates of 81.12 and 212.17 in 1945.

At anthracite operations, 153 of the fatal injuries happened in underground workings, 12 in surface works, and 9 in strippings. Falls of roof and face caused 104 fatalities or 68 percent of the total in underground workings. There were no major disasters in the anthracite industry during the year, and up to the close of 1946 only one such disaster had occurred in 8½ years.

METAL MINES

Injury experience in metal mines was less favorable in 1946 and the total injury-frequency rate (fatal and nonfatal) rose to 55.58 per million man-hours from 49.68 in 1945. The safety record was moderately to sharply worse in 1946 in each of the metal-mining groups except in lead-zinc mines, for which a moderately improved record was indicated. Employment gained to an average of 65,500 men who

worked a total of 131,010,000 man-hours or 8 percent below 1945. In 1946 these men worked an average 8.07-hour shift for 248 days and had an average workyear of 2,000 man-hours compared with an average 8.00-hour shift on 288 days for a total of 2,306 man-hours during 1945.

IRON

Employment.—The average number of men at work daily in iron mines increased about 1,000 over 1945 to a total of 24,500 in 1946. Owing principally to extensive work stoppages in the Lake Superior district in the early months of 1946, the mines were operated an average of only 226 days, whereas in 1945 the average was 286 days. As a result, man-hours and man-days of work each declined 17 percent from 1945. The average employee worked an 8.01-hour shift and had 1,812 hours of work in 1946 compared with 2,294 hours in 1945.

Employment and injury experience at metal mines in the United States, 1944–46, by industry groups [1]

	Men working daily	Average active mine-days	Man-days worked	Man-hours worked	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Fatal	Non-fatal
Iron mines:								
1944	25,852	282	7,299,664	58,557,525	39	1,412	0.67	24.11
1945	23,443	286	6,696,157	53,781,487	36	1,326	.67	24.66
1946	24,500	226	5,540,000	44,390,000	25	1,200	.56	27.03
Copper mines:								
1944	18,826	315	5,936,435	47,495,695	38	2,552	.80	53.73
1945	14,542	305	4,434,654	35,474,475	23	1,531	.65	43.16
1946	13,600	275	3,739,000	29,910,000	23	1,565	.77	52.32
Lead-zinc mines:								
1944 [2]	16,576	294	4,865,222	38,746,762	41	3,786	1.06	97.71
1945	14,645	292	4,273,405	34,161,578	29	2,976	.85	87.12
1946	16,200	257	4,167,000	33,780,000	29	2,830	.86	83.78
Gold-silver mines:								
1944	2,783	249	693,517	5,529,603	5	403	.90	72.88
1945	3,992	290	1,159,370	8,846,366	4	556	.45	62.85
1946	4,500	259	1,165,000	9,250,000	8	765	.86	82.70
Gold placers:								
1944	1,287	185	238,321	2,022,888	--------	48	--------	23.73
1945	1,819	175	318,102	2,683,598	--------	64	--------	23.85
1946	3,700	222	820,000	7,260,000	1	225	.14	30.99
Miscellaneous: [3]								
1944	5,156	259	1,333,292	10,816,716	7	708	.65	65.45
1945	3,029	279	845,950	6,786,457	4	492	.59	72.50
1946	3,000	267	802,000	6,420,000	--------	610	--------	95.02

[1] Data for 1946 are preliminary.
[2] Revised figures.
[3] Includes antimony, bauxite, chromite, cobalt, manganese, mercury, molybdenum, pyrite, titanium, tungsten, and vanadium-uranium mines.

Injuries.—The number of fatal and nonfatal injuries in iron mines decreased to 25 and 1,200, respectively, from 36 and 1,326 in 1945. However, owing to the reduced man-hours of exposure, the fatality rate was improved only slightly over 1945, and the nonfatality rate of 27.03 lost-time injuries per million man-hours in 1946 was well above the 24.66 rate in 1945.

COPPER

Employment.—Employment at copper mines declined 6 percent from 1945 to a total of 13,600 men working daily in 1946. The decline resulted primarily from lower employment reported for Michigan and Montana operations. Owing in part to local labor-management disputes at several large mines, the weighted average days active for all mines fell from 305 in 1945 to 275 in 1946. As indicated by reported man-hours of work, the activity of open-pits was about one-fifth and of underground mines about one-tenth below 1945. Total man-hours at all copper mines were 16 percent less than in 1945. In 1946 the average shift was 8.00 hours and the average work-year per man 2,199 man-hours, or 240 less than in 1945.

Injuries.—Although the injury record for copper mines had improved sharply in 1945, all of the improvement was lost in 1946. Injury rates in 1946 were 0.77 fatal and 52.32 nonfatal injuries per million man-hours compared with 0.65 and 43.16 in 1945. In 1946 injuries occurred more frequently in both open-pit and underground operations. Despite the marked reduction in total time of exposure, there were as many fatalities and slightly more nonfatal injuries in 1946 as in 1945.

LEAD-ZINC

Employment.—Available reports indicate that employment in lead-zinc mines advanced over 1945 to a total of 16,200 men in 1946. However, the total man-hours worked in these mines were slightly lower than in 1945 because the mines were operated an average of 257 days in 1946 or 35 less than in 1945. The average employee worked an 8.11-hour shift for a total of 2,085 man-hours in 1946, or 248 hours below 1945.

Injuries.—The more favorable injury record of lead-zinc mines in 1946 resulted from an improvement in nonfatal-injury experience. A total of 29 fatal injuries in 1946, the same as in 1945, occurred at a rate of 0.86 per million man-hours of exposure to hazard. Nonfatal injuries totaled 2,830 in 1946 and had a frequency of 83.78 per million man-hours in 1946, or slightly lower than in 1945.

GOLD AND SILVER LODE

Employment.—The average number of men at work in gold and silver lode mines during 1946 totaled 4,500, a gain of 13 percent over 1945. Although the mines were worked an average of 31 days less than in 1945, the enlarged labor force had a total worktime 5 percent greater than in 1945. Each employee worked an average shift of 7.94 hours and had a workyear of 2,056 man-hours in 1946—160 hours below 1945.

Injuries.—Injury experience in 1946 was considerably worse than in 1945. The number of fatalities doubled to a total of 8 in 1946, and these occurred at a frequency of 0.86 per million man-hours. Nonfatal injuries increased to 765 in 1946, or 209 more than in 1945. The nonfatal frequency rate of 82.70 in 1946 was appreciably higher than in 1945.

GOLD PLACER

Employment.—Employment at gold placers doubled in 1946 to a total of 3,700 men, who worked an average of 222 days or 47 days

more than in 1945. Man-hours worked in placers during 1946 nearly tripled the 1945 total. The average length of shift was 8.85 hours, and the average hours worked per man-year totaled 1,962, or 487 man-hours more than in 1945.

Injuries.—The number of nonfatal injuries increased sharply to 225 in 1946 owing to the greater time of exposure. These injuries occurred at a rate of 30.99 in 1946 compared to 23.85 in 1945. There was 1 fatality in 1946 and none in 1945.

MISCELLANEOUS METAL

Employment.—The labor force of 3,000 men in 1946 was virtually the same as in 1945 in the mines of this group, which includes antimony, bauxite, chromite, cobalt, manganese, mercury, molybdenum, pyrite, titanium, tungsten, and vanadium-uranium operations. However, the mines were operated an average of 12 days less than in 1945, so that the total man-hours of work declined slightly in 1946. The average length of shift was 8.00 hours and the average workyear per man was 2,140 hours, or 100 hours below 1945.

Injuries.—No fatalities were reported during 1946 at any of the mines in this group, whereas 4 occurred in 1945. However, the number of nonfatal injuries increased in 1946 more than 100 to a total of 610, which occurred at a frequency of 95.02 per million man-hours, or well above the 1945 rate.

NONMETAL MINES

Employment.—The average number of men at work daily increased 16 percent over 1945 to a 1946 total of 12,000 men in this group of mines, which comprises barite, feldspar, fluorspar, gypsum, magnesite, mica, phosphate rock, rock salt, sulfur, and miscellaneous nonmetallic-mineral operations. As these mines were worked an average of only 4 days less than in 1945, the total man-hours of work gained appreciably in 1946. The average man worked a 7.99-hour shift and a total of 2,290 hours during the year.

Injuries.—The safety record of nonmetal mines was less favorable than in 1945, and both fatal and nonfatal injuries occurred more frequently in 1946. The 24 fatalities were 8 more than in 1945, and the frequency of 0.87 per million man-hours was well above the 1945 rate. There were 245 more nonfatal injuries in 1946 than in 1945, and the total of 1,390 occurred at a rate of 50.58 compared with 46.52 in 1945.

QUARRIES

Over-all injury experience in the quarry industries in 1946 was changed only slightly from 1945. The rate of occurrence of fatal injuries was reduced in 1946 but this improvement was compensated for by a slightly less favorable frequency of nonfatal injuries. The combined rate of fatal and nonfatal injuries was 33.42 in 1946 compared with 32.83 in 1945. Operating activity in each of the quarry industries increased in 1946 and the total man-hours worked in all quarries was 28 percent greater than in 1945. The increased activity resulted in a sharp gain in employment to a total of 73,500 men or 26 percent above 1945. Also, the average days of operation of all quar-

ries was increased to 270 in 1946. The average worker had an 8.17-hour shift and had a total of 2,209 man-hours of work during the year compared with an 8.27-hour shift and 2,186 hours of work in 1945.

CEMENT

Employment.—Employment in cement quarries and mills gained sharply over 1945 to a total of 25,800 men who worked an average of 311 days in 1946 or 26 days more than in 1945. As a result, man-hours of worktime were nearly one-third above 1945. The average length of shift was 7.92 hours, and the work-year per man in 1946 was 2,462 hours—157 hours longer than in 1945.

Employment and injury experience at nonmetal mines and quarries in the United States, 1944–46, by industry groups [1]

	Men working daily	Average active mine-days	Man-days worked	Man-hours worked	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Fatal	Non-fatal
Nonmetal mines: [2]								
1944	11,261	282	3,173,150	25,760,287	17	1,283	0.66	49.81
1945	10,371	291	3,015,980	24,612,921	16	1,145	.65	46.52
1946	12,000	287	3,441,000	27,480,000	24	1,390	.87	50.58
Quarries:								
Cement: [3]								
1944	20,605	278	5,732,650	45,753,529	15	637	.33	13.92
1945	20,858	285	5,944,040	48,078,750	9	600	.19	12.48
1946	25,800	311	8,025,000	63,530,000	11	845	.17	13.30
Limestone:								
1944	18,182	244	4,444,813	37,810,478	29	1,596	.77	42.21
1945	17,704	234	4,150,750	35,182,061	24	1,381	.68	39.25
1946	22,600	226	5,107,000	43,270,000	26	2,015	.60	46.57
Lime: [3]								
1944	8,653	317	2,746,525	22,341,513	14	1,050	.63	47.00
1945	8,162	297	2,420,409	19,615,613	8	961	.41	48.99
1946	9,000	299	2,695,000	21,600,000	3	1,055	.14	48.84
Marble:								
1944	1,450	266	385,549	3,324,810	1	102	.30	30.68
1945	1,748	256	446,645	3,792,968	2	164	.53	43.24
1946	2,700	256	691,000	5,940,000	-------	180	-------	30.30
Granite:								
1944	4,278	248	1,060,087	8,953,052	6	385	.67	43.00
1945	4,067	249	1,014,288	8,615,078	7	396	.81	45.97
1946	5,700	250	1,424,000	11,970,000	3	510	.25	42.61
Traprock:								
1944	1,994	229	457,189	3,892,117	3	228	.77	58.58
1945	2,079	235	487,940	4,135,498	-------	195	-------	47.15
1946	2,900	230	667,000	5,590,000	3	255	.54	45.62
Slate:								
1944	1,071	261	279,109	2,386,768	3	146	1.26	61.17
1945	988	259	256,235	2,301,264	-------	115	-------	49.97
1946	1,300	278	361,000	3,320,000	2	180	.60	54.22
Sandstone:								
1944	2,243	261	584,737	4,839,658	2	293	.41	60.54
1945	2,574	255	655,920	5,447,089	3	309	.55	56.73
1946	3,500	253	887,000	7,110,000	2	335	.28	47.12

[1] Data for 1946 are preliminary.
[2] Includes barite, feldspar, fluorspar, gypsum, magnesite, mica, phosphate rock, rock salt, sulfur, and miscellaneous nonmetallic-mineral mines.
[3] Includes burning or calcining and other mill operations.

Injuries.—The longer time of exposure to hazard in 1946 was accompanied by an increase in the number of both fatal and nonfatal injuries. The 11 fatalities in 1946 occurred at a rate of 0.17 per million man-hours, a slight improvement over 1945. The frequency of nonfatalities was less favorable, and the rate of occurrence of these injuries rose to 13.30 in 1946 compared with 12.48 in 1945.

LIMESTONE

Employment.—The average number of men at work daily in limestone operations advanced to 22,600 in 1946; these men worked an average of 226 days for 43,270,000 man-hours, or 23 percent more than in 1945. The average length of shift was 8.47 hours, and each employee worked an average of 1,915 hours during the year.

Injuries.—The preliminary totals of 26 fatal and 2,015 nonfatal injuries were higher than in 1945 and occurred at respective frequencies of 0.60 and 46.57 per million man-hours. The rate of fatalities improved slightly in 1946; but for nonfatal injuries the rate was considerably less favorable than in 1945, when the frequency was 39.25.

LIME

Employment.—Employment at lime plants and associated quarries increased to 9,000 men in 1946; and, as the plants were active an average of 2 days longer, the total man-hours of work were 10 percent greater than in 1945. The average worker in the lime industry had a shift of 8.01 hours and a workyear of 2,400 hours, which was virtually the same as in 1945.

Injuries.—Fatality experience in 1946 was improved sharply; the 3 fatal injuries occurred at a rate of 0.14 per million man-hours, whereas in 1945 the 8 fatalities had a frequency rate of 0.41. The estimated total of 1,055 nonfatal injuries was higher than in 1945; but, owing to the increased time of exposure, the rate of occurrence remained at the same level in 1946.

MARBLE

Employment.—Reports indicate that 2,700 men were working daily in marble operations in 1946, a sharp gain over 1945 which resulted in a similar increase in the total man-hours worked. The average length of shift in 1946 was 8.60 hours, and the average number of hours per man-year was 2,200.

Injuries.—The industry was free of fatal accidents in 1946 compared with 2 fatalities in 1945. The nonfatal-injury rate was reduced appreciably—from 43.24 in 1945 to 30.30 per million man-hours in 1946.

GRANITE

Employment.—Employment in 1946 increased appreciably to a total of 5,700 men who worked an average of 250 days for a total worktime that was more than one-third above 1945. The average man had a shift of 8.41 hours and a workyear of 2,100 hours.

Injuries.—Despite the greater time of exposure, the number of fatalities was reduced in 1946 to 3, a frequency of 0.25 per million man-hours, or less than one-third the rate in 1945. The 510 nonfatal injuries occurred at a rate of 42.61, which was well below the 1945 frequency.

TRAPROCK

Employment.—The number of men working at traprock quarries increased to 2,900, who worked an aggregate of 5,590,000 man-hours, or 35 percent more than in 1945. The average employee worked an 8.38-hour shift and had a total worktime of 1,928 hours during the year.

Injuries.—There were 3 fatalities in the industry in 1946, whereas in 1945 none occurred. Although the number of nonfatal injuries was greater in 1946, the rate of occurrence—45.62 per million man-hours—was moderately below the 1945 rate.

SLATE

Employment.—An average of 1,300 men worked in slate quarries in 1946, a marked gain over 1945. The quarries were operated an average of 19 days longer in 1946, and the aggregate total worktime increased sharply over 1945. The average shift was 9.20 hours, and the average hours per man-year were 2,554, or 225 hours more than in 1945.

Injuries.—The preliminary totals of 2 fatalities and 180 nonfatalities in 1946 occurred at frequencies of 0.60 and 54.22 per million man-hours of work. These rates were less favorable than the corresponding frequencies in 1945.

SANDSTONE

Employment.—Employment at sandstone quarries advanced to a total of 3,500 men who worked an average of 253 days for an aggregate of 7,110,000 man-hours, 31 percent above 1945. The average employee had a shift of 8.02 hours and a man-year total of 2,031 hours.

Injuries.—Injury experience was improved markedly in 1946, and the frequencies of both fatal and nonfatal injuries were well below the 1945 rates. The 2 fatal and 335 nonfatal injuries occurred at respective rates of 0.28 and 47.12 per million man-hours of work in 1946.

COKE PLANTS

The fatality record of coke plants was improved sharply in 1946, but the nonfatality experience was less favorable than in 1945. Total employment declined in 1946, because fewer men were working in byproduct plants, more than compensating for the gain in employment at beehive plants. Apparently the byproduct plants during the extensive coal and steel strikes in 1946 worked on a longer than ordinary coking cycle and hence required fewer men in these periods.

BYPRODUCT COKE

Employment.—The average number of men working in byproduct-coke plants declined 9 percent from 1945 to a total of 18,700 men, who had a total worktime in 1946 10 percent below 1945. The reduced labor force and worktime were caused by the long work stoppages in the steel and bituminous-coal industries, which apparently forced parts of byproduct plants into a standby condition and/or lengthened the coking cycle; each of these would lower employment and worktime. The average length of shift in byproduct coke plants in 1946 was 8.03 hours and the average man-year 2,853 hours.

Injuries.—The 8 fatalities in 1946 were less than half as many as in 1945, and these occurred at a rate of 0.15 per million man-hours. Despite the shorter worktime, the number of nonfatal injuries increased to 685 in 1946, and occurred at a frequency of 12.84 compared with 10.91 in 1945.

Employment and injury experience at coke plants in the United States, 1944–46 [1]

	Men working daily	Average active plant-days	Man-days worked	Man-hours worked	Number of injuries		Injury rates per million man-hours	
					Fatal	Nonfatal	Fatal	Nonfatal
Byproduct ovens:								
1944	21,586	363	7,839,149	62,848,032	12	752	0.19	11.97
1945	20,454	356	7,290,410	59,292,507	17	647	.29	10.91
1946	18,700	355	6,641,000	53,350,000	8	685	.15	12.84
Beehive ovens:								
1944	3,180	267	848,183	6,742,049	3	236	.44	35.00
1945	2,533	247	625,031	5,082,575	1	188	.20	36.99
1946	2,800	201	562,000	4,550,000		170		37.36

[1] Data for 1946 are preliminary.

BEEHIVE COKE

Employment.—Employment at beehive plants advanced to a total of 2,800 men in 1946. However, the plants were active 46 days less than in 1945, owing to the coal and steel strikes, so that the total man-hours of work declined 10 percent from 1945. In 1946 the average worker had an 8.10-hour shift and a 1,625-man-hour work-year, 382 hours less than in 1945.

Injuries.—No fatal injuries were reported for beehive plants in 1946, whereas in 1945 there was 1. The preliminary total of 170 nonfatal injuries in 1946 had a frequency of 37.36 per million man-hours of work or relatively the same rate as in 1945.

METALLURGICAL PLANTS

Injury experience at metallurgical plants was slightly less favorable in 1946 than in 1945, and the frequency rates of both fatal and nonfatal injuries were slightly higher. Employment declined 4 percent from 1945, but total worktime fell 17 percent, owing primarily to extensive strikes in nonferrous smelters and refineries in the first half of 1946. The average length of shift was 7.91 hours, and the average work per man-year totaled 2,259 man-hours, or 356 less than in 1945.

ORE-DRESSING PLANTS AND AUXILIARY WORKS

Plants or mills in this group are those in which ores of all metals are processed by the various methods of treatment.

Employment.—The average number of men working in all metal mills in 1946 declined slightly to a total of 15,400 men, owing to decreased employment in each group except gold-silver mills. In the last group, employment increased sharply, but the gain offset the declines in the other groups only in part. The decrease in total worktime was in much greater proportion than in employment, owing doubtless to work stoppages in the mills as well as in the associated mines and smelters. The average employee worked 7.95 hours per shift and 2,084 hours during the year, or 342 hours less than in 1945.

Employment and injury experience at metal mills in the United States, 1944–46, by metals [1]

	Men working daily	Average active mill-days	Man-days worked	Man-hours worked	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Fatal	Non-fatal
Copper:								
1944	6,558	347	2,272,602	18,103,817	5	424	0.28	23.42
1945	5,891	327	1,923,926	15,439,427	2	322	.13	20.86
1946	5,700	284	1,619,000	12,600,000	1	385	.08	30.56
Iron:								
1944	3,384	258	873,964	7,074,375	3	97	.42	13.71
1945	3,283	261	855,859	6,946,659	1	134	.14	19.29
1946	3,100	200	620,000	5,060,000	1	65	.20	12.85
Gold-silver:								
1944	623	281	174,834	1,397,894	--------	72	--------	51.51
1945	600	294	176,380	1,383,341	--------	48	--------	34.70
1946	1,000	270	270,000	2,190,000	--------	75	--------	34.25
Lead-zinc:								
1944	5,185	308	1,598,024	12,798,732	8	446	.63	34.85
1945	4,368	304	1,329,693	10,650,753	5	400	.47	37.56
1946	4,200	276	1,159,000	9,290,000	6	285	.65	30.68
Miscellaneous metals: [2]								
1944	2,382	295	701,605	5,667,200	1	181	.18	31.94
1945	1,650	292	482,379	3,885,264	1	128	.26	32.94
1946	1,400	265	371,000	2,960,000	1	85	.34	28.72
Total:								
1944	18,132	310	5,621,029	45,042,018	17	1,220	.38	27.09
1945	15,792	302	4,768,237	38,305,444	9	1,032	.23	26.94
1946	15,400	262	4,039,000	32,100,000	9	895	.28	27.88

[1] Includes crushers, grinders, washers, ore concentration, sintering, cyaniding, leaching, and all other metallic ore-dressing plants and auxiliary works. Data for 1946 are preliminary.
[2] Includes antimony, bauxite, mercury, manganese, tungsten, chromite, vanadium, molybdenum, and other metals.

Injuries.—The over-all safety record of metal mills was less favorable than in 1945, and both the fatality and nonfatality rates were slightly higher in 1946. Fatality experience was improved only in copper mills and was less favorable in iron, lead-zinc, and miscellaneous metal mills. There have been no fatalities in gold-silver mills since 1943. Nonfatal-injury experience was improved in varying degrees in each group of metal mills except copper mills, for which the frequency of nonfatal injuries increased from 20.86 in 1945 to 30.56 per million man-hours in 1946.

SMELTERS, REFINERIES, REDUCTION PLANTS, AND AUXILIARY WORKS

Plants in this classification are engaged in the primary extraction of nonferrous metals from ores and concentrates and include, among others, smelters, refineries, and reduction, roasting, electrolytic, and retort plants. Iron and steel plants are excluded.

Employment.—Employment in each group of plants in this classification was slightly lower in 1946, and the total dropped to 29,300 men, or 4 percent below 1945. Man-hours of work in 1946 fell 17 percent below 1945, owing principally to widespread and prolonged work stoppages during the first half of 1946. The plants were active an average of 298 days in 1946, or 44 less than in 1945. The average shift was 7.90 hours and the worktime per man-year was 2,351 hours in 1946 compared to 2,712 hours in 1945.

Employment and injury experience at primary nonferrous smelters, refineries, and reduction plants in the United States, 1944–46, by metals [1]

	Men working daily	Average active smelter-days	Man-days worked	Man-hours worked	Number of injuries		Injury rates per million man-hours	
					Fatal	Non-fatal	Fatal	Non-fatal
Copper:								
1944	12,233	354	4,332,274	34,658,190	11	665	0.32	19.19
1945	10,420	347	3,612,376	28,947,308	4	541	.14	18.69
1946	10,200	289	2,946,000	23,230,000	6	505	.26	21.74
Lead, silver-lead:								
1944	3,448	328	1,132,488	9,059,857	1	141	.11	15.56
1945	3,698	323	1,193,484	9,538,276	2	177	.21	18.56
1946	3,600	252	908,000	7,270,000		165		22.70
Zinc:								
1944	10,693	357	3,819,081	30,119,862	6	975	.20	32.37
1945	9,944	350	3,482,249	27,701,226	1	857	.04	30.94
1946	9,900	339	3,356,000	26,200,000	4	915	.15	34.92
Miscellaneous metals: [2]								
1944	13,579	310	4,208,206	33,445,888	3	1,157	.09	34.59
1945	6,613	334	2,211,852	16,998,447	3	664	.18	39.06
1946	5,600	270	1,511,000	12,190,000		330		27.07
Total:								
1944	39,953	338	13,492,049	107,283,797	21	2,938	.20	27.39
1945	30,675	342	10,499,961	83,185,257	10	2,239	.12	26.92
1946	29,300	298	8,721,000	68,890,000	10	1,915	.15	27.80

[1] Includes smelters, refineries, and reduction, roasting, electrolytic, retort, and all other nonferrous metal reduction plants. Data for 1946 are preliminary.
[2] Includes mercury, antimony, tin, and magnesium plants.

Injuries.—Although the number of fatalities was the same and nonfatalities lower than in 1945, the frequency of both fatal and nonfatal injuries was higher in 1946, owing to the lower total worktime. The rate of fatalities in 1946 in copper smelters was nearly double and in zinc refineries nearly quadruple the corresponding rates in 1945. There were no fatal injuries in lead, silver-lead, or miscellaneous metal smelters in 1946—favorable records compared with 1945. Nonfatal-injury experience was improved sharply in miscellaneous metal smelters but was less favorable in each of the other groups of smelters.

PART II. COMMODITY REVIEW

Abrasive Materials

By ROBERT W. METCALF AND A. B. HOLLEMAN

	PAGE		PAGE
General summary	92	Garnet	103
Diatomite	94	Corundum	104
Tripoli	96	Emery	106
Quartz	97	Abrasive or industrial diamonds	106
Ground sand and sandstone	98	Artificial abrasives	107
Abrasive sands	99	Miscellaneous abrasives	109
Special silica-stone products	99	Foreign trade	109
Pumice and pumicite	101		

GENERAL SUMMARY

THE OUTPUT of ground sand and sandstone, diatomite, and pumice and pumicite established new highs in 1946. Production of natural abrasives in 1946 rose to 1,205,497 short tons valued at $11,150,959, an increase of 23 percent in quantity and 14 percent in value over 1945. Artificial abrasives (silicon carbide, aluminum oxide, and metallic abrasives), however, declined 12 percent in tonnage and 8 percent in value compared with 1945. Natural abrasive products in 1946 comprised 80 and 36 percent, respectively, of the total tonnage and value of artificial and natural abrasives combined, as against 74 and 31 percent in 1945. Marketed output of garnet was the highest since 1925. Production of tripoli, quartz, grindstones, and tube-mill liners were substantially higher in 1946 than in 1945. Contrary to the trend of the other artificial abrasives, output of silicon carbide showed a large gain. Sales of grinding pebbles dropped sharply, and emery output also declined.

The total value of imports of natural abrasive materials in 1946 rose 14 percent to $15,320,284. The major part of this increase was due to the 10-percent rise in value of bort (glaziers' and engravers' diamonds, unset, and miners') although accompanied by a large decrease in caratage compared with 1945. Other diamond-import classifications showed large increases in both quantity and value. Emery ore (all from Turkey) and Italian pumice were imported for the first time since 1940. Garnet imports increased substantially. Imports of "flint, flints, and flintstones, unground" were the largest since 1939. Corundum-ore receipts decreased by one-third. The value of exports of natural abrasive products in 1946 totaled $2,426,853, 16 percent higher than in 1945. Grindstone exports were valued at $285,799, the highest since 1929.

Salient statistics of the abrasives industries in the United States, 1945–46

	1945		1946		Percent of change in 1946	
	Short tons	Value	Short tons	Value	Short tons	Value
Natural abrasives:						
Domestic production (sold or used by producers):						
Diatomite	[1] 174,957	[1] $3,298,178	[1] 174,957	[1] $3,298,178		
Tripoli	18,247	306,829	28,955	549,099	+59	+79
Quartz	57,764	236,803	73,179	293,852	+27	+24
Ground sand and sandstone	533,656	3,709,597	575,888	4,125,398	+8	+11
Grindstones	10,033	399,565	11,605	501,444	+16	+25
Pulpstones	[2]	[2]	72	3,880		
Oilstones and related products	[3]	[3]	[3]	[3]		
Millstones	[4]	15,018	[4]	14,780		−2
Tube-mill liners	1,982	45,933	2,375	44,247	+20	−4
Grinding pebbles	8,615	201,806	4,652	102,043	−46	−49
Pumice and pumicite	157,011	1,051,037	319,883	1,585,753	+104	+51
Garnet	6,306	375,198	7,743	570,186	+23	+52
Emery	7,856	75,977	6,188	62,099	−21	−18
Total natural abrasives [3]	980,780	9,801,988	1,205,497	11,150,959	+23	+14
Artificial abrasives:						
Silicon carbide—production [5]	53,773	4,238,655	63,849	5,457,903	+19	+29
Aluminum oxide—production [5]	147,016	9,130,093	132,084	8,367,158	−10	−8
Metallic abrasives (steel shot and grit)—shipments	146,771	8,524,073	111,512	6,387,819	−24	−25
Total artificial abrasives	347,560	21,892,821	307,445	20,212,880	−12	−8
Total abrasives	1,328,340	31,694,809	1,512,942	31,363,839	+14	−1
Foreign trade:						
Imports	[6]	13,493,381	[6]	15,320,284		+14
Exports	[6]	2,087,598	[6]	2,426,853		+16

[1] Average annual figure for 1942–44. Bureau of Mines not at liberty to publish 1945 and 1946 data.
[2] Data included in total; Bureau of Mines not at liberty to publish figures.
[3] Data for oilstones and related products not included in totals; Bureau of Mines not at liberty to publish figures.
[4] Tonnage of millstones not recorded.
[5] Includes Canadian production.
[6] Weight cannot be reported because of varying units.

This chapter includes data for most of the materials used chiefly as abrasives, although certain clays, oxides, carbides, and other substances mentioned later under Miscellaneous Mineral Abrasive Materials are not included in the statistics presented herein. On the other hand, certain of the abrasive products for which figures are shown also have important nonabrasive uses.

A summary of the improvements and outstanding developments in the abrasive field has been published.[1] The importance and relative usefulness of natural and manufactured products in modern industry is stressed. Various applications and technological advances, including the growing use of manufactured abrasives and the cemented carbides, are discussed. Many applications of natural abrasive materials are cited. Lesser [2] studied the composition and comparative polishing effect of metal polishes in liquid, paste, powdered, and cake, brick, or block form. Resources of grinding pebbles, diatomite, abrasive and other polishing materials, including abrasive sands in Texas [3] and

[1] Waggaman, W. H., and Ralston, O. C., Abrasives—Technological Advances in an Essential Industry: Chem. and Eng. News, vol. 24, No. 10, October 1946, pp. 2612–2615; also in Industrial Diamond Review, vol. 7, No. 77 (new ser.), April 1947, pp. 110–111.
[2] Lesser, Milton A., Metal Polishes: Soap and Sanitary Chemicals, vol. 22, No. 12, December 1946, pp. 147, 149, 151, 153.
[3] Sellards, E. H., and Lonsdale, John T., Texas Mineral Resources: Univ. Texas Pub. 4301, Austin, 1946, 390 pp.

pumice and the volcanic materials in New Mexico,[4] were outlined and their commercial possibilities appraised.

Recommendations for grinding and polishing plastics, including kinds of abrasives employed, wheel speeds, and methods of operation were reported.[5] Wells presented a brief survey of the buffing and polishing industries.[6] Useful methods for quick and reliable analysis and accurate sizing of abrasive particles, including emery and corundum powders, used in the grinding and polishing of glass have been developed.[7] Advantages and disadvantages of the great variety of fats and oils used as suspending mediums for abrasives were outlined by Steinitz.[8]

Coating abrasive grains to increase glue adherence has been in use for many years. A low-melting molybdenum-bearing frit, with subsequent application of an inert pigment to produce the rough or mat surface required for good adherence of the glue to the grain, has been applied commercially to sizes as small as No. 180 and experimentally to No. 500 abrasive grain. Grain coated in this manner tends to fracture rather than pull out, resulting in longer life and cooler, faster cutting. It is claimed that the abrasive properties of both fused alumina and silicon carbide grain are improved by this coating material.[9] Heat treatment of coated abrasive products toughens them and imparts greater resistance to heat and less sensitivity to high humidities.[10] Descriptions of the various types of industrial sandpapers and their composition and uses were published.[11]

The National Bureau of Standards Simplified Practice Recommendation R 89–46 for Coated Abrasive Products, issued in 1946, lists grade numbers, recommended sizes and type of coating and backing for 1,737 "standard" items of coated products, classified according to kind of abrasive employed. European practice in the manufacture of abrasive papers was presented in considerable detail.[12] The principal abrasives used are glass, flint, emery, alumina, and silicon carbide. Adhesives and the weight, composition, and characteristics of the paper used were discussed.

NATURAL SILICA ABRASIVES

Diatomite.—The Bureau of Mines has not been at liberty to publish annual production statistics on diatomite since 1926. Total output (sales) for 3-year periods, however, may be shown. Total sales for the three most recent such periods were as follows: 1936–38, 279,645 short tons valued at $4,377,353; 1939–41, 360,502 tons valued at $5,746,216; and 1942–44, 524,872 tons valued at $9,894,534. The

[4] Kutnewsky, Fremont, Nonmetallic Minerals of New Mexico: Compressed Air Mag., vol. 51, No. 8, August 1946, pp. 211–216.

[5] Norton Company and Society of Plastics Industry, Inc., Sanding Recommendations for Plastics: Am. Machinist, vol. 90, No. 17, 1946, p. 143; abs. in Jour. Am. Ceram. Soc., vol. 29, No. 11, Nov. 1, 1946, p. 189.

[6] Wells, E. W., Buffing and Polishing—A Survey: Monthly Rev. Am. Electroplators' Soc., vol. 33, pp. 803–806; Chem. Abs., vol. 40, No. 20, Oct. 20, 1946, p. 6004.

[7] Golba, J. E., [Control of Abrading Materials in Glass Grinding and Polishing Shops]: Stekolnaya i Keram. Prom., 1944, No. 3, pp. 14–22; abs. in Am. Ceram. Soc. Jour., vol. 29, No. 5, May 1, 1946, p. 79; Ind. Diamond Rev., vol. 7, No. 76, March 1947, pp. 72–73.

[8] Steinitz, E. W., Fats and Oils Used for Grinding and Polishing: Ind. Diamond Rev., vol. 6, No. 72, November 1946, pp. 330–332.

[9] Journal, American Ceramic Society, Coated Abrasive Grain: Vol. 29, No. 4, Apr. 1, 1946, p. 92.

[10] Grits and Grinds, Durabonded Coated Abrasives Increase Production: Vol. 36, No. 9, 1945, pp. 10–12; abs. in Jour. Am. Ceram. Soc., vol. 29, No. 6, June 1, 1946, p. 97.

[11] Trowbridge, T., Coated Abrasives as Production Tools: Grits and Grinds, vol. 36, No. 10, 1945, pp. 5–7; abs. in Jour. Am. Ceram. Soc., vol. 29, No. 6, June 1, 1946, p. 97.

[12] Papeterie, Manufacture of Abrasive Papers: Vol. 26, 1946, pp. 110–114; Chem. Abs., vol. 41, No. 3, Feb. 10, 1947, p. 862.

high level of output indicated in the 1942–44 period was exceeded in 1945 and again by a considerable margin in 1946.

The chief producing States in 1946 were California, Oregon, Nevada, and Washington, with minor amounts from Arizona and New York. California is the largest producer in the United States. California, Nevada, and Washington each showed large increases over 1945, whereas Oregon's output remained at approximately the same level as in 1945. Although precise statistics of uses of diatomite cannot be shown, it may be stated that filtration accounted for somewhat over half of the total shipments; fillers took about one-fifth of sales, and insulation about one-eighth. Miscellaneous uses, including small amounts for fine abrasives, comprised the rest.

Quotations on diatomite in 1946, as reported in E&MJ Metal and Mineral Markets, were as follows: Per ton f. o. b. mill, Nevada, crude, in bulk, dried, nominal; 98 to 100-mesh, $25; low-temperature insulation, $25; high-temperature insulation, $40; fine abrasive, 2 to 3 cents per pound. (Bags are extra.) California filtration grades were quoted at $20 to $50 per ton f. o. b. mill.

The development of diatomite for water filtration in place of sand for both military and industrial purposes was described, and the possibilities for wider utilization were evaluated.[13] Filtration of sugar liquors through special Monel cloth, using diatomite as the filtering medium, resulted in more efficient operation and less frequent cleaning of filters.[14] The manufacture of an insulating block containing large proportions of diatomaceous earth was described.[15]

A study of the Monterey formation in California includes a description of the large diatomaceous earth and shale deposits in this area and a discussion of their origin.[16] A detailed description of diatomite recovery operations of the Dicalite Division, Great Lakes Carbon Corp., was presented by Green.[17] Mention was made in the trade press of the lightweight aggregate manufactured from diatomite, "Airox," which was used in the building of concrete ships and barges.[18]

Occurrence and utilization of diatomite in northeastern Brazil were described by Leonardos.[19] Efforts to develop the Scottish diatomite deposits, especially those on the Isle of Skye, for use in industrial insulation are being continued.[20] Native sources of supply of materials (including diatomaceous earth) suitable for mineral fillers in the Australian rubber industry were outlined by Whitworth.[21] The relative heat conductivity of granulated vermiculite and diatomite

[13] Applebaum, S. B., Filtration of Water Through Diatomaceous Earth: Water and Sewage Works, vol. 93, No. 8, August 1946, pp. 308–310; Chem. Abs., vol. 41, No. 2, Jan. 10, 1947, p. 546. Proportioneer, Inc., Diatomaceous Earth Filtration: Bull. 1550, 1946, 11 pp. Engineering News Record, Diatomite Filters Offer Advantages in Industrial Applications: Vol. 137, No. 22, Nov. 28, 1946, p. 57.

[14] Black, R. F., Mechanical Filtration with Metal Filter Cloth: Internat. Sugar Jour., vol. 48, 1946, pp. 207–208; Chem. Abs., vol. 40, No. 21, Nov. 10, 1946, pp. 6856–6857.

[15] Kieselbach, H. H., and Williams, E. R., High-temperature Insulating Shape and Method of Manufacture (assigned to Johns-Manville Corp.): U. S. Patent 2,388,549, Nov. 6, 1945; abs. in Jour., Am. Ceram. Soc., vol. 29, No. 1, Jan. 1, 1946, p. 12.

[16] Bramlette, M. N., The Monterey Formation of California and the Origin of Its Siliceous Rocks: Geol. Survey Prof. Paper 212, 1946, 57 pp.

[17] Green, Robert J., Digging for Dicalite: Excavating Engr., vol. 40, 1946, pp. 292–294, 340; Abs. in Bull. Am. Ceram. Soc., vol. 29, No. 10, Oct. 1, 1946, p. 180.

[18] Pit and Quarry, vol. 39, No. 6, December 1946, p. 81.

[19] Leonardos, Othon A., [Occurrence of Diatomite in Ceara, Brazil]: Mineracao e Met., vol. 11, No. 61, 1946, pp. 21–30; Chem. Abs., vol. 41, No. 3, Feb. 10, 1947, pp. 668–669.

[20] Chem. Age., Diatomite in Scotland: Vol. 53, No. 1358, 1945, p. 10; abs. in Am. Ceram. Soc. Abs., vol. 29, No. 1, Jan. 1, 1946, p. 17.

[21] Whitworth, H. F., Australian Sources of Supply of Mineral Fillers for the Rubber Industry. Trans., Inst. Rubber Ind., vol. 22, 1946, pp. 25–30; Chem. Abs., vol. 40, No. 20, Oct. 20, 1946, p. 6286.

and diatomite brick fired in a reducing atmosphere were determined in Russian experiments.[22] The use and manufacture of diatomite in the wartime German ceramic industry were described.[23]

Tripoli.—Output of tripoli, amorphous silica, and rottenstone in 1946 rose 59 percent in quantity and 79 percent in value over 1945, to 28,955 short tons valued at $549,099. This represented the highest tonnage since 1941 and the highest realization since 1928. Production in Illinois increased 40 percent in quantity and 75 percent in value compared with 1945. Other States producing these materials for sale in 1946 were Missouri and Pennsylvania.

The principal uses of tripoli are as abrasives, chiefly as an ingredient of polishing and buffing compounds, and as filler. Tonnages reported sold for abrasive use in 1946 were 91 percent greater than in 1945, and sales for fillers increased 12 percent. Tripoli sold for "other uses", including foundry facings, rose 4 percent. A short study of the mining, milling, and marketing of tripoli was published.[24]

Tripoli (including Pennsylvania rottenstone) sold or used by producers in the United States, 1942–46

Year	Illinois		Missouri and Pennsylvania [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1942	12,575	$203,390	4,961	$69,038	17,536	$272,428
1943	10,203	168,758	4,709	75,607	14,912	244,365
1944	12,031	205,732	6,394	96,131	18,425	301,863
1945	11,144	184,189	7,103	122,640	18,247	306,829
1946	15,631	321,600	13,324	227,499	28,955	549,099

[1] Includes Arkansas in 1942–44 and Oklahoma in 1943. Missouri and Pennsylvania figures in 1945 and 1946 were as follows: 1945–Missouri, 6,542 tons, $114,188; Pennsylvania, 561 tons, $8,452. 1946–Missouri, 12,180 tons, $211,244; Pennsylvania, 1,144 tons, $16,255.

Tripoli (including Pennsylvania rottenstone) sold or used by producers in the United States, 1944–46, by uses

Use	1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value
Abrasives	13,218	$210,592	11,113	$188,262	21,206	$406,620
Concrete admixture	316	4,552	1	18		
Filler	3,423	66,147	3,969	65,569	4,450	89,721
Oil-well drilling	(1)	(1)				
Other uses [2]	1,468	20,572	3,164	52,980	3,299	52,758
	18,425	301,863	18,247	306,829	28,955	549,099

[1] Included under "Other uses." [2] Foundry facing, drilling mud, and unspecified.

As reported in E&MJ Metal and Mineral Markets, quotations on tripoli were the same in 1946 as in 1945 and 1944 (per short ton, f. o. b. Missouri, in paper-lined burlap bags, minimum carlot 30 tons): Once ground, through 40-mesh, rose or cream colored, $14.50; double-

[22] Budrin, D. V., and Golubev, I. I., [The Effect of Hydrogen on Heat Conductivity of Heat-insulating Materials]: Trudy Ural. Ind. Inst. in S. M. Kirova No. 17, 1941, pp. 76–96; Chem. Abs., vol. 40, No. 13, July 10, 1946, pp. 3861–3862.

[23] British Intelligence Objectives Subcommittee, German Porous Ceramic Industry: Final Rept. 143, Items No. 22 and 31, 1944, 24 pp.

[24] Metcalf, Robert W., Tripoli: Bureau of Mines Inf. Circ. 7371, 1946, 25 pp.

ground, through 110-mesh, rose or cream, $16; air-floated, through 200-mesh, $26. Quotations on rottenstone in 1946, as given in Oil, Paint and Drug Reporter, remained unchanged compared with 1945 and 1944: Carlots, in bags, at mines, $25.50 per short ton; less than carlots, $37.50 per ton.

Firms actively producing tripoli, amorphous silica, and rottenstone in 1946 were the same as in 1945: Illinois (amorphous silica)—Tamms Silica Co., 228 N. LaSalle St., Chicago, Ill., with plant at Olive Branch, and Ozark Minerals Co., Cairo; Oklahoma (mine) and Missouri (mill)—Barnsdall Tripoli Corp., Seneca, Mo.; and Pennsylvania (rottenstone)—Penn Paint & Filler Co., Antes Fort, and Keystone Filler & Mfg. Co., Muncy.

Quartz.—Sales of crude, crushed, and ground quartz from pegmatite veins or dikes and from quartzite in 1946 increased 27 percent in tonnage and 24 percent in value compared with 1945. Sales of crude quartz rose 58 percent.

Crushed quartz rose only slightly, and sales of ground material increased 15 percent. The average value per ton of all quartz sold in 1946 dropped to $4.02 compared with $4.10 in 1945.

Quartz (crude, crushed, and ground) [1] sold or used by producers in the United States, 1942–46

Year	Crude		Crushed		Ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1942	2,043	$7,937	45,747	$144,808	18,088	$178,749	65,878	$331,494
1943	6,134	55,600	84,233	183,507	9,078	107,451	99,445	346,558
1944	15,222	35,279	61,823	170,325	5,334	80,874	82,379	286,478
1945	24,392	72,392	28,718	93,631	4,654	70,780	57,764	236,803
1946	38,587	107,069	29,228	109,437	5,364	77,346	73,179	293,852

[1] To avoid duplication, the ground material shown here is only that ground by the original producers of the crude quartz or by grinders who purchase from small miners not reporting their production.

Quartz (crude, crushed, and ground) [1] sold or used by producers in the United States, 1944–46, by States

State	1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value
Arizona, California, Washington, Oregon	67,109	$206,477	36,044 1,462	$99,113 16,260	41,844	$160,266
Maine	88	203	4	10		
Massachusetts			696	6,349	829	7,715
Virginia	75	303	(2)	(2)		
Other States [3]	15,107	79,495	19,558	115,071	30,506	125,871
	82,379	286,478	57,764	236,803	73,179	293,852

[1] To avoid duplication, the ground material included is only that ground by the original producers of the crude quartz or by grinders who purchase from small miners not reporting their production.
[2] Included with "Other States."
[3] 1944: Maryland, New Jersey, North Carolina, Tennessee, and Wisconsin; 1945: Maryland, New Jersey, North Carolina, South Dakota, Virginia, and Wisconsin; 1946: Maryland, North Carolina, South Dakota, Tennessee, and Wisconsin.

Sales of quartz in 1946 were reported in 10 States, 2 less than in 1945. States not listed as producers in 1946, but which had some output in 1945, were Maine, New Jersey, and Virginia. Tennessee which had no output in 1945 reported production in 1946. Increases in sales largely were in Western States. Quotations on ground "hard quartz" silica in 1946, as reported in Oil, Paint and Drug Reporter, were the same as in 1945: 325-mesh (99½ percent grade), carlots in bags, $15.50 per ton, and less than carlots, $18.50; 140-mesh (99½ percent grade), carlots in bags, $11 per ton, and less than carlots, $16.

Ground Sand and Sandstone.—Sales of ground sand and sandstone in 1946 totaled 575,888 short tons, valued at $4,125,398 (a new high), 3 percent greater in both quantity and value than in the former record year (1944). Sales in 1946 were 8 percent higher than in 1945. Average value per ton rose from $6.95 per ton in 1945 to $7.16, or slightly above that in 1944 ($7.14). Sales in Illinois, one of the larger producing States, were virtually the same in 1946 as in 1945. Output in California-Washington in 1946 was nearly twice that in 1944 (1945 data not comparable), and Ohio-Virginia-West Virginia gained 20 percent in 1946 compared with 1945. The principal producing States other than Illinois were New Jersey, Ohio, and Pennsylvania.

Ground sand and sandstone sold or used by producers in the United States, 1942–46

Year	Short tons	Value	Year	Short tons	Value
1942	527,886	$3,646,643	1945	533,656	$3,709,597
1943	541,350	3,937,452	1946	575,888	4,125,398
1944	558,606	3,989,981			

Ground sand and sandstone sold or used by producers in the United States, 1944–46, by States

State	1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value
Arizona						
California	20,872	$208,925	20,610	$225,450		
Washington			(1)	(1)	39,401	$215,889
Georgia	3,090	19,823	7,190	27,858	4,406	25,993
Illinois	158,673	1,098,275	144,212	1,003,273	144,753	1,061,046
Massachusetts	2,500	12,000	2,350	11,600	2,000	10,000
New Jersey	173,551	1,139,818	181,076	1,084,284	105,985	649,828
Pennsylvania					(1)	(1)
Ohio, Virginia, and West Virginia	152,514	1,182,255	142,002	1,102,135	169,710	1,396,151
Other States [2]	47,406	328,885	36,216	254,997	109,633	766,491
	558,606	3,989,981	533,656	3,709,597	575,888	4,125,398

[1] Included under "Other States."
[2] 1944: Louisiana, Missouri, North Carolina, and Wisconsin; 1945: Missouri, Washington, and Wisconsin; 1946: Missouri, Pennsylvania, and Wisconsin.

Distribution of sales of ground sand and sandstone by uses, as reported by firms producing 90 percent of the total sales, indicated that in 1946 the chief consumers of these products, in the order of total quantity consumed, were the pottery, porcelain, and tile industries (40 percent of the tonnage for which uses were reported), makers of cleaning and scouring compounds or other abrasive products (20 percent), foundries (14 percent), and glass manufacturers (11 percent). Filler, enamel, and miscellaneous uses account for the remaining tonnage for which data are shown.

Ground sand and sandstone sold or used by producers in the United States in 1946, by uses [1]

Use	Short tons	Value	
		Total	Average per ton
Abrasive:			
Cleansing and scouring compound	103,247	$626,158	$6.06
Other	410	2,784	6.79
Enamel	24,723	167,537	6.78
Filler	26,204	204,531	7.81
Foundry	73,277	514,144	7.02
Glass	56,138	365,075	6.50
Pottery, porcelain, and tile	210,729	1,705,525	8.09
Other uses [1]	26,328	197,085	7.49
Total reported by uses	521,056	3,782,839	7.26

[1] Data represent 90 percent of the industry.

Abrasive Sands.—Natural sands with a high silica content are employed for sandblasting, stone polishing, glass grinding, coating sandpaper, or other abrasive use. Sales of such grinding and polishing sand in 1946 totaled 906,889 short tons valued at $1,379,954, or an increase of 41 percent in quantity and 34 percent in value over 1945. Included in the 1946 data were 292,899 tons of blast sand valued at $736,819. Information with respect to tonnages produced in each State, where these figures may be published, appears in the Sand and Gravel chapter of this volume.

SPECIAL SILICA-STONE PRODUCTS

Grindstones and Pulpstones.—Sales of grindstones in 1946 increased 16 percent in quantity and 25 percent in value, compared with 1945 and represented the highest level in tonnage and value since 1942 and 1929, respectively. A small quantity of pulpstones was produced in Washington. As in 1945, grindstones were produced in Ohio and West Virginia.

Oilstones and Related Products.—In 1946 sales of natural sharpening stones, including oilstones, whetstones, scythestones, and rubbing stones, were higher than in 1945, but the Bureau of Mines is not at liberty to publish the figures. Producing States in 1946, and type of abrasive stone reported from each, were: Arkansas—oilstones and whetstones; Indiana—rubbing stones and whetstones; New Hampshire—scythestones; and Ohio—scythestones, whetstones, rubbing stones, and "other" sharpening stones, including lathestones.

Grindstones and pulpstones sold by producers in the United States, 1942–46

Year	Grindstones		Pulpstones		
	Short tons	Value	Quantity		Value
			Pieces	Equivalent short tons	
1942	12,763	$422,763	528	1,918	$116,976
1943	10,732	392,296	323	1,891	95,909
1944	9,373	356,106	(1)	(1)	(1)
1945	10,033	399,565	(1)	(1)	(1)
1946	11,605	501,444	22	72	3,880

[1] Bureau of Mines not at liberty to publish figure.

Millstones.—The value of sales of millstones and chasers in 1946 decreased slightly compared with 1945. Marketed production of millstones and chasers in 1946 was reported by George Coddingham and Henry Lawrence, both of Accord, N. Y., with deposits in Ulster County, and of millstones by Gardner Granite Works, Salisbury, N. C., with deposit in Rowan County, and Interstate Millstone Co., Christiansburg, Va., with deposit in Montgomery County.

Value of millstones and chasers sold by producers in the United States, 1942–46[1]

Year	Number of producers	Value	Year	Number of producers	Value
1942	5	$10,391	1945	4	$15,018
1943	4	9,240	1946	4	14,780
1944	3	9,700			

[1] New York, North Carolina, and Virginia; in addition, Minnesota in 1945.

Grinding Pebbles and Tube-Mill Liners.—Sales of grinding pebbles and tube-mill liners combined dropped 34 percent in quantity and 41 percent in value in 1946, compared with 1945. Sales of grinding pebbles in 1946 declined 46 percent in quantity, whereas tonnage of tube-mill liners sold increased 20 percent, although the value declined slightly. Grinding pebbles and tube-mill liners in 1946 were produced in the following States: Grinding pebbles in California, Minnesota, North Carolina, Texas, Washington, and Wisconsin, and tube-mill liners in Minnesota, North Carolina, and Wisconsin.

Grinding pebbles and tube-mill liners sold or used by producers in the United States, 1942–46

Year	Grinding pebbles		Tube-mill liners		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1942	15,487	$245,794	2,576	$49,967	18,063	$295,761
1943	9,924	157,778	2,585	46,071	12,509	203,849
1944	8,012	172,418	2,063	38,833	10,075	211,251
1945	8,615	201,806	1,982	45,933	10,597	247,739
1946	4,652	102,043	2,375	44,247	7,027	146,290

In 1946 the following firms produced for sale the products indicated: John T. Momand, Carlsbad, Calif., beach pebbles; Jasper Stone Co., Sioux City, Iowa, quartzite liners and artificially rounded grinding pebbles (quarries at Jasper, Minn.); Southern Products & Silica Co., Lilesville, N. C., silica grinding pebbles; Harris Granite Quarries Co., Salisbury, N. C., granite liners and rounded cubes; Peeler & McCombs, Faith, N. C., granite liners and rounded cubes; Dezendorf Marble Co., Austin, Tex., flint pebbles; Mineral Products Co., Seattle, Wash., grinding pebbles; and Baraboo Quartzite Co., Baraboo, Wis., quartzite pebbles and liners.

The use of massive quartzite from the Sioux formation of South Dakota as tube mill liners [25] and of quartzite pebbles from southwestern Saskatchewan as grinding media [26] was described.

NATURAL SILICATE ABRASIVES

Pumice and Pumicite.—The output of pumice and pumicite (volcanic ash) again rose to a new high in both quantity and value in 1946 and totaled 319,883 short tons valued at $1,585,753, or 104 percent in tonnage and 51 percent in value above 1945, the previous record year. This phenomenal increase was due almost solely to the greatly expanded use of pumice and pumicite in building operations in Western States.

Pumice and pumicite sold or used by producers in the United States, 1942–46

Year	Short tons	Value	Year	Short tons	Value
1942	126,522	$706,199	1945	157,011	$1,051,037
1943	85,150	611,495	1946	319,883	1,585,753
1944	88,757	704,110			

Pumice and pumicite sold or used by producers in the United States, 1944–46, by States

State	1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value
California	31,409	$245,898	75,238	$481,664	89,181	$755,570
Colorado					600	1,200
Idaho			(1)	(1)	108,847	163,515
Kansas	43,034	163,538	47,484	187,651	35,466	105,084
Nebraska	6,083	51,043	6,764	59,735	4,772	45,900
New Mexico	(1)	(1)	(1)	(1)	62,623	432,890
Oregon	(1)	(1)	(1)	(1)	3,004	12,532
Texas	(1)	(1)	584	11,680	805	13,054
Washington	783	8,705	4,414	36,045	14,585	56,008
Undistributed [1]	7,448	234,926	22,527	274,262		
	88,757	704,110	157,011	1,051,037	319,883	1,585,753

[1] Figures that may not be shown separately are combined as "Undistributed."

[25] Blackburn, A. R., Massive Quartzite—Refractory Material for Handling Molten Iron and Steel: Ohio State Univ. Studies, Eng. Exper. Sta. Bull. 124, 1945, 34 pp.; Chem. Abs., vol. 40, No. 13, July 10, 1946, p. 3862.

[26] Furnival, G. M., Cypress Lake Map-Area, Saskatchewan: Can. Dept. Mines and Resources, Geol. Survey, Pub. 2475, 1946, 161 pp.; abs. in Jour. Am. Ceram. Soc., vol. 30, No. 2, Feb. 1, 1947, p. 43.

Production was reported in nine States in 1946, the same as in 1945, but with the addition of a small output from Colorado. Idaho became the principal producer, with virtually all of its output used for aggregate. California in 1946 had the second highest production, followed by New Mexico and Kansas. Decreases of 25 and 29 percent were reported for Kansas and Nebraska. All other States, however, had large gains in 1946 compared with 1945.

Pumice and pumicite sold for concrete admixture and concrete aggregate in 1946 totaled 248,247 short tons, 241 percent above 1945 and more than 4½ times that used for abrasive purposes. Consumption for acoustic plaster also increased, as well as for "other uses," which in 1946 included insecticides, insulation, paint filler, and absorbents.

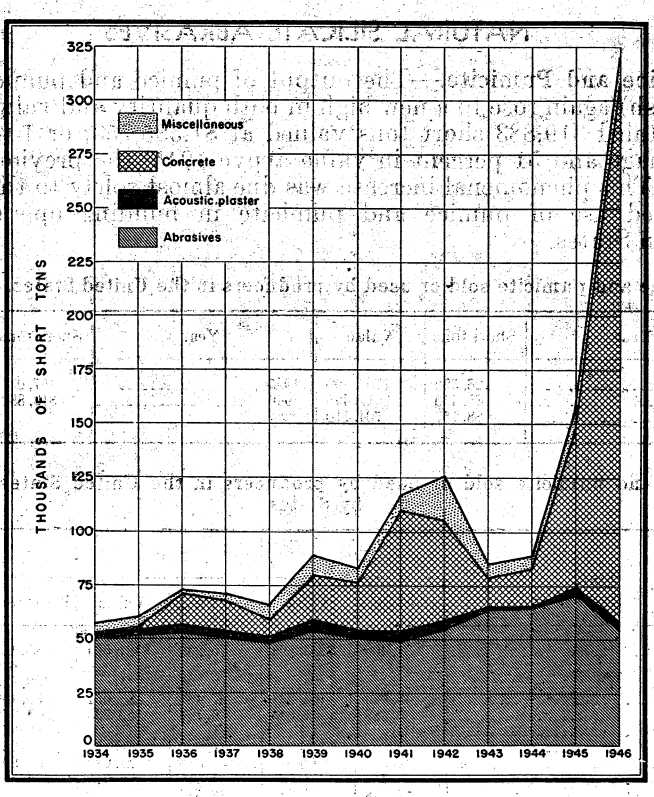

FIGURE 1.—Trends, by uses, of pumice and pumicite sold or used in the United States, 1934–46.

As given in E&MJ Metal and Mineral Markets, pumice quotations in 1946 were the same as in 1945 and 1944 (f. o. b. New York or Chicago, in barrels): Lump, 5 to 7½ cents per pound, and powdered, 2½ to 4½ cents per pound.

To serve the expanded market for lightweight aggregate using pumice, Basalt Rock Co., Napa, Calif., has built a new plant near Stockton, Calif., to make lightweight concrete masonry from pumice

Pumice and pumicite sold or used by producers in the United States, 1944–46, by uses

Use	1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value
Abrasive:						
Cleansing and scouring compounds and hand soaps	57,833	$375,310	63,704	$434,928	52,085	$386,593
Other abrasive uses	6,094	136,753	7,307	229,212	2,369	112,694
Acoustic plaster	938	29,144	3,693	78,278	4,342	139,871
Concrete admixture and concrete aggregate	17,511	90,136	72,901	176,020	248,247	607,695
Other uses [1]	6,381	72,767	9,406	131,699	12,840	338,900
Total	88,757	704,110	157,011	1,051,037	319,883	1,585,753

[1] Insecticide, insulation, brick manufacture, filtration, solvents, plastics, paint filler, absorbents, and unspecified.

aggregate and portland cement.[27] The officers of this same company also have formed a new firm to manufacture another type of pumice containing the lightweight aggregate "Rocklite" at Ventura, Calif.[28]

Expansion of operations mining or making use of pumice and pumicite as an aggregate material were reported from California,[29] Colorado,[30] Oregon,[31] and Utah.[32] Experiments with volcanic ash as the major ingredient of ceramic glazes indicated its value for this purpose.[33] The operations of a large west coast producer of lightweight concrete using pumice as aggregate were detailed.[34]

A description of Italian pumice deposits, including preparation, classification, and marketing, was published.[35]

Garnet.—Production of garnet in 1946 increased to 7,743 short tons valued at $570,186, a gain of 23 percent in quantity and 52 percent in value compared with 1945. This was the largest tonnage sold since 1925 and the highest reported value since 1927. The trend in output (sales) of garnet since 1920 is shown in figure 2. Producers of garnet reporting to the Bureau of Mines in 1946 were: Garnet Mines, Inc., Fernwood, Idaho; Idaho Garnet Abrasive Co., P. O. Box 1452, Spokane 6, Wash. (deposit at Fernwood, Idaho); Barton Mines Corp., North Creek, N. Y.; and Estate of John Burnham, Essex, N. Y. Separation of garnet from hornblende by the Barton Mines Corp., North Creek, N. Y. was described.[36] An Alaskan garnet field is being mapped by the United States Geological Survey.[37]

Quotations on domestic garnet in 1946 as given in E&MJ Metal and Mineral Markets were unchanged from 1945 and immediately preceding years: New York Adirondack garnet concentrates, grain—$85 per short ton.

[27] Pit and Quarry, vol. 39, No. 9, March 1947, p. 137.
[28] Rock Products, vol. 50, No. 3, March 1947, p. 62.
[29] Pit and Quarry, vol. 39, No. 9, March 1947, p. 150; Rock Products, vol. 50, No. 3, March 1947, p. 145; Concrete, vol. 55, No. 3, March 1947, p. 20.
[30] Pit and Quarry, vol. 39, No. 3, September 1946, p. 79.
[31] Rock Products, vol. 50, No. 2, February 1947, pp. 126–127.
[32] Engineering and Mining Journal, vol. 148, No. 1, January 1947, p. 118.
[33] Carey, J. Sheldon, Glazes from Volcanic Ash: abs. in Bull. Am. Ceram. Soc., vol. 26, No. 3, Mar. 15, 1947, p. 64.
[34] Rock Products, Largest Products Plant on West Coast: Vol. 50, No. 2, February 1947, pp. 147–149.
[35] Bureau of Mines, Mineral Trade Notes: Vol. 22, No. 5, May 1946, pp. 33–39.
[36] Pit and Quarry, vol. 39, No. 6, December 1946, p. 82.
[37] Engineering and Mining Journal, vol. 147, No. 10, 1946, p. 112; abs. in Jour., Am. Ceram. Soc., vol. 30, No. 2, Feb. 1, 1947, p. 39.

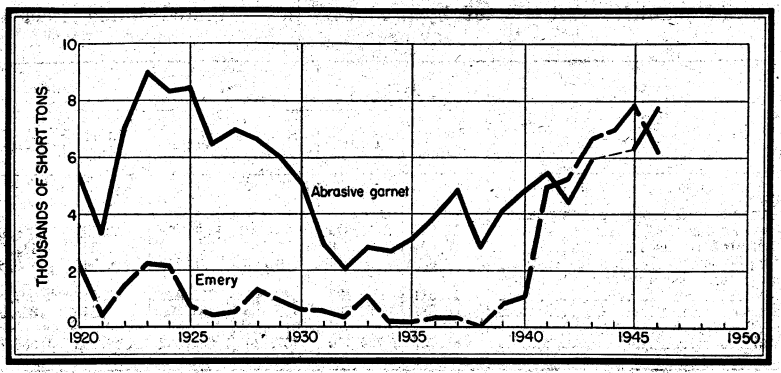

FIGURE 2.—Marketed production in the United States of abrasive garnet and domestic emery, 1920–46.

Abrasive garnet sold or used by producers in the United States, 1942–46

Year	Short tons	Value	Year	Short tons	Value
1942	4,357	$299,904	1945	6,306	$375,198
1943	5,935	429,120	1946	7,743	570,186
1944	(1)	(1)			

[1] Bureau of Mines not at liberty to publish figure.

NATURAL ALUMINA ABRASIVES

Corundum.—Corundum, a natural alumina abrasive, Al_2O_3, was especially needed during the war for use in snagging wheels by firms manufacturing tanks, guns, and other military equipment and for polishing highly essential precision lenses. Efforts to establish and foster a domestic corundum industry in North and South Carolina and Montana resulted only in a small, almost negligible output, which was consumed largely for experimental purposes. Similar exploration and tests of corundum in Douglas County, Nev., also proved unproductive.[38]

Most of the corundum consumed in the United States for many years originated in the Union of South Africa, particularly in the Transvaal. In normal years, this source furnished a fairly steady supply despite the handicaps of distance and transportation. Production in South Africa during the war was stimulated by the Foreign Economic Administration and other agencies. An account of the situation existing in the African producing areas was published.[39] Improvements have been made in the Pietersburg plant. Boulder shipments virtually ceased at the beginning of 1946, and crystal output also declined markedly. The South African producing company plans the erection of a new mill to manufacture optical and wheel grain and to recover corundum schist, which can be used in a polishing compound for metals and plastics.[40]

[38] Binyon, E. O., Exploration of the Blue Metal Corundum Property, Douglas County, Nev.: Bureau of Mines Rept. of Investigations 3895, 1946, 7 pp.
[39] Metcalf, Robert W., Corundum in Southern Africa: Bureau of Mines, Mineral Trade Notes, vol. 24, No. 2, Special Suppl. 12, February 1947, 13 pp.
[40] South African Mining and Engineering Journal, vol. 57, No. 2800, Oct. 12, 1946, p. 125.

Although imports for consumption in the United States rose considerably during the war years, the receipts were scarcely adequate to satisfy the greatly enlarged demand for production of optical apparatus and heavy equipment required by the Army and Navy. The supply of corundum still is short of possible consumption. After the high level of imports in 1944 and 1945, receipts in 1946 dropped 33 percent under 1945, to 4,207 short tons, the lowest figure since 1940. Supplementing imports from the Union of South Africa, shipments from other countries occasionally have been received, including Canadian material recovered from tailings dumps of mines inactive since World War I. Detailed description of this operation, including cost data, flow sheet, operating methods, and recovery results, were published during 1946.[41] The results of field concentration tests on corundum with a Harz jig were described in detail in the South African press.[42] Deposits of corundum in Brazil and possibilities for development were outlined.[43]

World production of corundum in recent years as far as statistics are available appears in the accompanying table.

World production of corundum, 1937–46, by countries, in metric tons [1]

Country [1]	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946
Australia (New South Wales)	------	------	------	------	------	------	------	------	[2] 10	([3])
Belgian Congo	------	------	------	------	------	------	------	[4] 5	([3])	([3])
Brazil	------	------	------	------	------	------	------	100	([3])	([3])
Canada	------	------	------	------	------	------	------	[5] 157	[5] 1,195	[5] 1,080
French Equatorial Africa	------	------	------	------	------	------	------	------	140	46
India	------	------	1	([6])	56	135	110	349	299	([3])
Madagascar	27	35	5	------	------	------	14	70	50	([3])
Nyasaland	------	------	------	------	([6])	81	180	305	328	379
Portuguese East Africa	------	------	------	------	------	------	834	1,108	152	([3])
Southern Rhodesia	([3])	([3])	([3])	([3])	([3])	([3])	[4] 551	([3])	[4] 14	13
Swaziland	------	------	------	------	------	15	141	------	------	------
Tanganyika	------	------	------	------	------	------	5	------	------	------
Union of South Africa (sales)	2,237	1,397	2,381	3,820	6,119	6,723	4,270	3,536	4,374	1,854
United States (sales)	------	------	------	------	------	------	([7])	([7])	------	------
Total [8]	2,264	1,432	2,387	3,820	6,175	6,954	6,105	5,630	6,562	3,372

[1] In addition to countries listed, corundum probably is produced in U. S. S. R., but output data are not available.
[2] Reported as corundum and emery (believed to be largely emery).
[3] Data not available.
[4] Imports into United States.
[5] Recovered from tailings dumps.
[6] Less than 1 ton.
[7] Bureau of Mines not at liberty to publish figure.
[8] Totals represent only those countries for which statistics are shown.

Quotations on crude corundum imported in the United States are not given in domestic trade journals. Corundum grain throughout 1945 and 1946 was quoted in E&MJ Metal and Mineral Markets as follows: Per pound, sizes 8 to 60, inclusive, 8¾ cents; 70 to 275, inclusive, 9¾ cents; 500, 30 cents; 850 to 1000, inclusive, 45 cents; 1200 to 1600, inclusive, 60 cents; and 2600, 70 cents.

[41] Roach, A. G., Re-Treatment of Corundum-bearing Tailings at Craigmont: Trans. Canadian Inst. Min. and Met., vol. 49, 1946, pp. 636–664. Includes appendix by Eardley-Wilmot, V. C., Heavy Minerals Associated with the Craigmont Corundum, pp. 659–664.
[42] Levin, J., Corundum Concentration in the Field-Tests with Use of Harz Jig: Union of South Africa Dept. of Mines and Government Metallurgical Laboratory, Laboratory Report 105; abs. in South African Min. and Eng. Jour., vol. 57, No. 2787, July 13, 1946, pp. 491, 493, 495; No. 2788, July 20, pp. 517–520; No. 2789, July 27, pp. 549, 551, 553, 555.
[43] Bureau of Mines, Mineral Trade Notes, vol. 23, No. 4, Oct. 19, 1946, pp. 20–23.

Emery.—Sales of domestic emery in 1946 declined 21 percent in quantity and 18 percent in value from the high level in 1945. Production, however, was considerably higher than in any recent year prior to 1943. The entire output, as in other recent years, was mined in and near Peekskill, N. Y., by Joe DeLuca and DiRubbo & Ellis. Emery is shipped largely as crude rock to manufacturers of grinding wheels, abrasive sticks, polishing compositions, and similar materials. It also is marketed as grain to other makers of abrasive products. Considerable amounts are employed as a nonslip, wear-resistant component in concrete floors.

According to E&MJ Metal and Mineral Markets, quotations on crude domestic emery ore remained unchanged in 1946, compared with 1945: $10 per short ton for first-grade ore, f. o. b. New York. Grain emery was quoted in the same publication as follows (per pound, in 350-lb. kegs, f. o. b. Pennsylvania): Turkish and Naxos, 7 cents; and American, 5 cents. The emery deposits of Turkey were studied by De Lapparent,[44] who also discussed the deposits on the Grecian Islands of Naxos and Samos.

Emery sold or used by producers in the United States, 1942–46

Year	Short tons	Value	Year	Short tons	Value
1942	5,277	$49,413	1945	7,856	$75,977
1943	6,666	63,195	1946	6,188	62,099
1944	6,940	64,858			

NATURAL CARBON ABRASIVES[45]

Abrasive or Industrial Diamonds.—Consumption of industrial diamonds during the past few years has increased greatly, owing to their high efficiency and the low price maintained during the war. However, since the end of hostilities, prices have been increased somewhat. Obviously, high prices eventually may limit the use of industrial diamonds, but the demand was still very active in 1946.

Description of deposits in the Tanganyika field,[46] developed during the war, and reports of new discoveries in Brazil[47] were published. Information with respect to Russian diamond deposits also appeared in the trade press.[48]

British experience in the use of diamond tools in fine boring was detailed,[49] and the employment of diamond tools in the processing of plastics was described.[50] In the size-grading of diamond powders, a gelatin solution was found to give the most satisfactory dispersing action.[51] Problems solved in the development of vitrified-bonded

[44] De Lapparent, Jacques [Mineralogical Composition, Structure, and Origin of the Emeries of Turkey]: Compt. rend., vol. 223, No. 5, 1946, pp. 227–228; abs. in Jour. Am. Ceram. Soc., vol. 29, No. 11, Nov. 1, 1946, p. 200.

[45] See also Gem Stones chapter of this volume.

[46] Engineering and Mining Journal, vol. 147, No. 12, December 1946, p. 139.

[47] Foreign Commerce Weekly, vol. 24, No. 5, Aug. 3, 1946, p. 35.

[48] National Jeweler, Diamonds in Russia: November 1946, pp. 242, 244, 246.

[49] Industrial Diamond Review, Fine Boring Practice with Diamond Tools: Vol. 6, No. 68, July 1946, pp. 197–199.

[50] Mining Journal, Diamond Tools in the Plastics Industry: Vol. 227, No. 5803, Nov. 9, 1946, p. 893.

[51] National Bureau of Standards, Size Grading of Diamond Powders: Tech. News Bull. 349, May 1946, p. 38.

diamond grinding wheels [52] and the growing use of tungsten carbide-tipped tools as a competitor of diamond bits in rock drilling [53] were discussed in the technical press. An investigation of the methods of producing diamond dies was undertaken during the war by the National Bureau of Standards under the sponsorship of the War Metallurgy Committee of the National Academy of Sciences.[54]

ARTIFICIAL ABRASIVES

Production of artificial abrasives (silicon carbide, aluminum oxide, and metallic abrasives) totaled 307,445 short tons valued at $20,212,880, or a decrease of 12 percent in quantity and 8 percent in value compared with 1945. Output of aluminum oxide and shipments of metallic abrasives in 1946 both showed substantial declines. Production of silicon carbide, however, rose 19 percent in tonnage and 29 percent in value, to 63,849 short tons valued at $5,457,903, the highest figure since 1943. Operation of silicon carbide plants reached 89 percent of capacity, whereas activity in aluminum oxide and metallic abrasives was about 57 and 53 percent of reported capacity, respectively. Similarly, stocks of silicon carbide in 1946 showed a large increase over 1945, and stocks of aluminum oxide and metallic abrasives were considerably lower than in 1945.

Crude artificial abrasives sold, shipped, or used from manufacturing plants in the United States and Canada, 1942–46

Year	Silicon carbide [1]		Aluminum oxide [1]		Metallic abrasives [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1942	61,681	$4,904,309	183,633	$12,719,337	106,442	$5,618,913	351,756	$23,242,559
1943	69,706	5,912,590	217,425	13,202,270	124,954	7,083,141	412,085	26,198,001
1944	56,291	4,717,675	185,573	11,668,838	144,540	8,441,505	386,404	24,828,018
1945	53,773	4,238,655	147,016	9,130,093	146,771	8,524,073	347,560	21,892,821
1946	63,849	5,457,903	132,084	8,367,158	111,512	6,387,819	307,445	20,212,880

[1] Production: Bureau of Mines not at liberty to publish data for United States separately. Figures include material used for refractories and other nonabrasive purposes.
[2] Shipments from United States plants only.

Production of silicon carbide and aluminum oxide is concentrated largely in the Niagara Falls region of Canada and the United States; some aluminum oxide, however, also is manufactured in Quebec, Canada, and in Alabama. The same companies that produced aluminum oxide and silicon carbide in 1945 and other recent years were active in 1946, except that Abrasive Company of Canada, Arvida, Ltd., became Simonds Canada Abrasive Co., Ltd. Included in the total for aluminum oxide in 1946 were 12,853 short tons of "white high-purity or special material" valued at $1,412,950, a decrease of 32 percent in both quantity and value from the figures re-

[52] Bulletin, American Ceramic Society, Vitrified-Bonded Diamond Grinding Wheels: Vol. 25, No. 3, Mar. 15, 1946, p. 92–93.
[53] Mine and Quarry Engineering, A Major Development in Rock Drilling: Vol. 13, No. 2, February 1947, p. 33.
[54] Peters, C. G., and others, Final Report on Investigation of Small Diamond Dies: Nat. Bureau of Standards, in cooperation with War Metallurgy Committee, Nat. Acad. Sciences, Repts. PB–16402, PB–16403, PB–16404, PB–16405, PB–16406, PB–16407, and PB–16408 (mim.), pub. on various dates in 1943 and 1944.

ported in 1945. Silicon carbide consumed in refractory or other nonabrasive uses in 1946 was estimated at 43 percent of the total output, and aluminum oxide used for similar purposes in 1946 was estimated at 3 percent.

Stocks of crude artificial abrasives and capacity of manufacturing plants, as reported by producers in the United States and Canada, 1942–46, in short tons

Year	Silicon carbide		Aluminum oxide		Metallic abrasives [1]	
	Stocks at end of year	Capacity	Stocks at end of year	Capacity	Stocks at end of year	Capacity
1942	4,806	61,681	20,707	179,214	4,278	142,026
1943	9,384	70,938	28,360	222,602	2,524	169,500
1944	8,916	71,850	32,402	234,000	3,388	191,289
1945	4,347	72,000	31,933	233,300	10,433	209,360
1946	5,339	71,679	27,072	232,889	6,524	211,407

[1] Figures pertain to United States plants only.

Statistics for metallic abrasives cover steel shot and grit but not steel wool. In 1946, as in 1945 the principal producing States, in order of magnitude of shipments, were Ohio, Michigan, and Pennsylvania. Other States in which metallic abrasives were manufactured in 1946 were Illinois, Massachusetts, New Hampshire, and New York. Sixteen firms with 17 plants reported shipments in 1946, compared with 15 companies and 16 plants in 1945. The new company reporting shipments of steel shot and grit in 1946 was Metallic Abrasives, Inc., 1217 Second St., N. E., Canton, Ohio. A new firm in California reported a small output for experimental purposes only.

A new type of aluminous grain abrasive has been produced directly in the electric furnace, obviating crushing and milling, according to reports published in the trade press.[55] The grains have highly irregular surfaces, which provide cooler, faster, and more efficient cutting. The abrasion-resistant qualities of aluminous oxide were utilized in the manufacture of a nonslip cement for tile, safety treads, shower curbs, and similar uses.[56] A finely ground synthetic SiO_2–Al_2O_3 catalyst was found to produce greater quantities of light hydrocarbons for making alkylate and hydropolymer and a better aviation base stock than the natural SiO_2–Al_2O_3.[57] The preparation and properties of boron carbide were described briefly.[58] A study of the characteristics and properties of artificial sapphire was published.[59]

[55] Anthony, John, New Abrasive Reduces Grinding Costs: Iron Age, vol. 158, No. 21, 1946, pp. 56–59; Chem. Abs., vol. 41, No. 2, Jan. 10, 1947, p. 581. Steel, Toward Longer-Lived Abrasives: Vol. 119, No. 23, Dec. 2, 1946, pp. 104–105, 142, 144, 146.

[56] Johannes, Jr., Dana B. (assigned to International Products Co.), Nonslip Cement for the Manufacture of Tile: U. S. Patent 2,411,213, Nov. 19, 1946.

[57] Walter, J. F., Developments in Fluid Catalytic Cracking: Jour. Inst. Petrol., vol. 32, 1946, pp. 295–303; Chem. Abs., vol. 41, No. 2, Jan. 10, 1947, p. 589.

[58] Barberis, Nino [Boron Carbide, the New Abrasive]: Ind. Ceram. Silicati, vol. 1, No. 3, 1946, pp. 6–8; abs. in Jour. Am. Ceram. Soc., vol. 30, No. 1, Jan. 1, 1947, p. 1.

[59] Waindle, Roger F., Sapphire as a Production Tool: Am. Machinist, vol. 90, No. 12, 1946, pp. 101–104; abs. in Jour. Am. Ceram. Soc., vol. 29, No. 11, Nov. 1, 1946, p. 189.

MISCELLANEOUS MINERAL ABRASIVE MATERIALS

In addition to the natural and manufactured abrasive materials for which data are included herein, many other mineral substances are used for abrasive purposes. Various oxides, such as tin oxide, magnesia, rouge, crocus, cerium oxide, chromium oxide, and manganese oxide, are utilized as polishing agents. Among products used for abrasive properties or because of extreme hardness or durability are the carbides, such as boron carbide and the cemented carbides, which include tungsten carbide, tantalum carbide, and titanium carbide. Other substances with abrasive applications include finely ground and calcined clays (china clays, ball clays, fire clays), lime, talc, ground feldspar, river silt, slate flour, whiting, and other materials.

FOREIGN TRADE [60]

Imports.—The total value of imports of abrasive materials in 1946 increased 14 percent compared with 1945, the largest increase in value being for bort. However, this classification, comprising largely what are known as industrial grades, showed a sharp drop in caratage imported. Statistics for other types of diamonds for which 1946 import data are shown indicated large gains in quantity and value.

Abrasive materials imported for consumption in the United States, 1944–46, by kinds

Kind	1944		1945		1946	
	Quantity	Value	Quantity	Value	Quantity	Value
Burrstones: Bound up into millstones short tons	13	$854	22	$1,406	13	$1,099
Grindstones, finished or unfinished do	358	14,130	250	8,893	232	12,077
Hones, oilstones, and whetstones do	14	18,662	12	11,864	12	26,595
Emery:						
Ore do					2,561	33,358
Grains, ground, pulverized, or refined pounds	(1)	(1)	(1)	(1)	(1)	(1)
Paper and cloth coated with emery or corundum reams	890	77,652	718	89,333	873	130,660
Wheels, files, and other manufactures of emery or corundum or garnet pounds	50,559	16,642	26,323	5,115	4,378	4,113
Corundum (see also "Emery"):						
Ore short tons	6,402	437,306	6,244	456,581	4,207	340,891
Grains, ground, pulverized, or refined pounds	[1] 72,347	[1] 5,017	[1] 75,092	[1] 4,553	[1] 117,368	[1] 7,011
Garnet in grains, ground, etc do	400	6	6,100	92	38,874	2,373
Tripoli and rottenstone short tons	3	60	37	1,170	93	3,095
Pumice:						
Crude or unmanufactured do	40	1,398			5,471	61,190
Wholly or partly manufactured do					984	25,204
Manufactures, n. s. p. f				10		110
Diamonds:						
Bort, manufactured carats	12	1,266	1,099	28,721	2,104	63,674
Bort (glaziers' and engravers' diamonds, unset, and miners') carats	12,603,647	22,658,224	10,726,372	12,756,973	4,609,146	14,012,604
Carbonado and ballas do	10,860	236,020	3,497	53,959	16,136	284,932
Dust do	42,316	58,811	62,317	47,213	77,732	129,272
Flint, flints, and flintstones, unground short tons	651	7,590	1,323	27,498	6,965	182,026
		23,533,638		13,493,381		15,320,284

[1] Emery included with corundum; not separately classified.

[60] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Imports of crude or unmanufactured pumice and "flint, flints, and flintstones, unground," which includes grinding pebbles, were reported in substantial quantities for the first time since 1940. Until 1946, no imports of emery ore and wholly or partly manufactured pumice had been received in the United States since 1940. Shipments of "flint, flints, and flintstones, unground" originated chiefly in Denmark, Belgium, and France, and those of emery ore were from Turkey. Corundum ore receipts were 33 percent less than in 1945. The quantity and value of imports of corundum and emery grain and corundum- or emery-coated paper and cloth were considerably higher in 1946 than in 1945. Garnet showed a large increase.

The average value (foreign market value) per specified unit of physical volume of imports of corundum ore, corundum, and emery-coated paper and cloth, "flint, flints, and flintstones, unground," and all classifications of diamonds increased substantially in 1946 compared with 1945.

Exports.—The total value of exports of natural abrasive products in 1946 totaled $2,426,853, or 16 percent greater than that reported in 1945. The export value of grindstones ($285,799) was 13 percent above 1945, the highest figure since 1929. Emery and corundum wheels increased 51 percent in 1946 compared with 1945, and "all other" natural abrasives showed a substantial gain over 1945.

Value of abrasive materials exported from the United States, 1942–46

Material	1942	1943	1944	1945	1946
Grindstones	$224,998	$213,170	$155,048	$252,293	$285,799
Abrasive wheels, emery and corundum	3,665,386	1,295,011	342,215	144,589	218,961
All other natural abrasives, whetstones, hones, etc.	2,793,968	2,002,988	1,594,412	1,690,716	1,922,093
	6,684,352	3,511,169	2,091,675	2,087,598	2,426,853

Aluminum

By C. E. NIGHMAN AND MARY E. TROUGHT

GENERAL SUMMARY

FOR THE first time in history, in November 1946, with the revocation of price ceilings, the price of copper rose above that of virgin aluminum, and at the year end it stood about 30 percent higher. On the other hand, the price of aluminum has never advanced since 1925 but has shown a consistent decline, whereas the general price level has trended upward and sharply so since 1938.

Partial disposal in 1946 of Government-owned reduction facilities has gone far toward the attainment of the Government's goal of free competition in the industry. After midyear, metal production was divided between the Aluminum Co. of America, Permanente Metals Corp. (a Kaiser Co., Inc., subsidiary), and the Reynolds Metals Co. Of the privately owned or leased capacity (649,000 short tons) operative in December, Alcoa controlled nearly 51 percent, Reynolds 29 percent, and Kaiser 20 percent. In addition, about one-third more (234,000 tons) remained in Federal ownership.

A notable betterment in the domestic aluminum industry also characterized 1946, the first full year after the end of the active hostilities of World War II. Although primary aluminum production was 17 percent below that of 1945, it exceeded the immediate prewar (1935–39) average by 227 percent. In the first half year, output averaged about 25,000 tons monthly, then increased uninterruptedly through December, when it surpassed a 600,000-ton annual rate that prospective 1947 demand seemed likely to maintain.

Salient statistics of the aluminum industry, 1942–46

	1942	1943	1944	1945	1946
Primary production.....short tons..	521,106	920,179	776,446	495,060	409,630
Value.....	$151,371,000	$265,380,000	$222,416,000	$140,864,000	$115,812,000
Quoted price per pound.....cents..	[1] 15.0	[1] 15.0	[1] 15.0	[1] 15.0	15.0
Secondary production.....short tons..	196,464	313,961	325,645	298,387	278,073
Imports.....	$37,147,891	$41,817,044	$30,322,653	$99,348,667	$13,066,252
Exports.....	$26,943,686	$67,216,832	$89,796,339	$9,866,306	$20,284,053
World production.....short tons..	1,525,800	2,145,000	1,915,000	978,000	827,000

[1] Ceiling price. Control lifted Aug. 31, 1945.

Indicated or apparent consumption of virgin metal in 1946 was 42 percent below that reckoned for the preceding year. Actual consumption, however, was substantially higher. The failure of production to meet needs resulted in a heavy draft on primary metal stocks, both producers' and Government, exceeding 140,000 tons. Of the

year-end residual Government stocks (71,760 tons), virtually all was set aside by the Civilian Production Administration for industrial use. In addition, the War Assets Administration disposed of a substantial tonnage of mill products. Further, recoverable aluminum in aluminum-bearing scrap appears to have been absorbed.

Prices of standard grades of primary aluminum remained unchanged throughout the year at the levels reached in 1942. Late in the year fractional cent increases became effective for most of the major aluminum-base alloys in response to advances in the cost of alloy metals. There was a considerable range in quoted secondary metal prices, and at the year end some grades commanded premiums over corresponding primary grades.

World production declined to an estimated 750,000 metric tons in 1946 from 887,000 tons in 1945.

Aluminum ores, alumina, and aluminum salts are discussed in the Bauxite chapter of this volume.

PRODUCTION

Primary.—Domestic virgin aluminum production (409,630 short tons in 1946) was 17 percent less than in 1945 and only 45 percent of the 1943 peak. Nevertheless, this output was indicative of aluminum's greatly enhanced position as an engineering and constructional metal. For a quarter century through 1939, the average annual rate of production increase was less than 5,000 tons. From the depression low in 1934 through the first war year, 1939, the apparent rate of increase was 20,000 tons a year—a rate then greatly surpassed to 1946. The recent accelerated growth of the aluminum industry is perhaps more

Production of primary aluminum in the United States, 1941–46, by months, in short tons [1]

Month	1941	1942	1943	1944	1945	1946
January	21,800	32,250	60,650	84,750	48,650	24,750
February	19,500	30,100	55,600	74,400	45,650	22,250
March	22,200	34,400	64,600	80,200	53,100	26,000
April	22,900	35,000	66,800	77,800	51,600	25,900
May	25,200	37,200	72,850	76,450	52,000	24,850
June	25,800	39,500	74,150	66,400	47,500	27,800
July	27,000	45,000	78,450	67,550	47,900	35,750
August	27,900	48,950	81,350	61,650	45,800	39,850
September	27,600	49,550	86,400	47,450	31,600	41,100
October	29,500	54,150	94,050	48,400	25,000	45,000
November	29,000	55,000	91,350	44,450	20,800	46,300
December	30,800	60,000	93,600	46,850	24,000	50,700
Total: Preliminary	309,200	521,100	919,850	776,350	493,600	410,250
Final	309,067	521,106	920,179	776,446	495,060	409,630

[1] Monthly data 1941–July 1946 from producers' reports to War Production Board and its successor, Civilian Production Administration. Monthly data August–December 1946 and final annual figures 1941–46 from reports to Bureau of Mines.

clearly shown by comparison with growth in industrial production.[1] The index of production for 1939 was 109 and that for 1946, 170, an increase of about 56 percent. With the average production of aluminum for the same base period as 100, the index for 1946 is 328, an increase of 228 percent or closely four times that of industrial output as a whole.

[1] Federal Reserve Bank indexes of physical volume of industrial production, 1935–39=100, are used herein.

After termination of active warfare in 1945, the output rate had dropped to the 1941 level and remained there for the first half of 1946 owing to a combination of circumstances. (See accompanying table of production by months, 1941–46.) These included: Technical problems connected with a change-over to classes and types of products fitted to civilian use; the overhanging threat of great stocks of metal in various forms, estimated to have been over a million tons; and, at the beginning of the year, the unsolved problem of disposal of Government-owned plants, some of which were among the country's low-cost producers and others noncompetitive primarily because of excessive power costs. Further retardants were strikes within the aluminum industry and particularly the coal and steel strikes.

War-spurred technologic advances made many new alloys available; new production and application techniques were developed, and many thousands of workers were trained therein, while a multitude of fabricators and consumers became conversant with the properties and characteristics of the metal and its alloys and found them adaptable to a great diversity of products. Not the least in importance were the growing availability of the basic material, primary aluminum (accompanied by serious shortages of other nonferrous metals) and its relative price decline. (See section on Prices following.) The surplus stock threat was greatly relieved when it was found impracticable to return much of the crashed or obsolete aircraft scrap from the zones of military operations. Obviously, however, that potential source of usable material will restrain world primary production until absorbed. Further, the massive Government stocks have been released substantially as markets developed. Industrial reconversion had so far advanced by late spring that aluminum demand grew rapidly, but output did not pace it. Until October, when raised to 85 percent, only 60 percent of soda-ash needs could be met, and power supply became inadequate in some regions. In addition, mill capacity, notably for sheet, was insufficient to satisfy the demand. Despite the many hindrances, virgin-metal production was above a 550,000-ton annual rate in the last quarter of 1946 and in December topped a 600,000-ton rate. Production in 1947 is expected to be in that range.

The year 1946 was also notable for a reconstitution—economic and geographic—of the aluminum industry that grew out of the antitrust proceedings instituted in 1937 against the Aluminum Co. of America. The courts freed the company of other charges but adjudged it guilty of a monopoly of primary ingot production as late as 1940. In 1939 annual aluminum-reduction capacity, all Alcoa, was estimated at 175,000 tons. In 1940 the Reynolds Metals Co.—already an outstanding foil roller—entered the reduction field, adding about 80,000 tons capacity, and early in 1941 first cast ingots. At the same time Alcoa embarked on a 300-million-dollar self-financed expansion program which at completion raised its ingot capacity to about 330,000 tons. In 1941 and in 1942 the Government through the Defense Plant Corporation instituted plant-construction programs that originally called for additional primary capacity of about 625,000 tons. Subsequent plant expansions and improved performance of potlines brought the total United States capacity, according to the War Assets Administration, in 1944 to slightly less than 1,164,000 tons, of

which about 57 percent or 668,000 tons was in DPC plants. From completion to their closure by the end of October 1945, the nine Government- and privately-owned plants were operated by Alcoa, Reynolds, and Olin Corp., whose operating shares of total capacity in 1944 were respectively 91.3, 6.9, and 1.8 percent.

Under the terms of the Surplus Property Act and rulings of the Attorney General, Alcoa was prohibited from acquiring any of the eventual surplus Government plants that would tend to perpetuate its adjudged monopoly. Attempts to induce other companies to

Rated annual capacity of alumina and aluminum plants in the United States at the end of 1946 [1]

Company and plant	Alumina (from bauxite)			Aluminum ingot		
		Percent of—			Percent of—	
	Thousands of short tons	Capacity owned or leased by private companies	Total capacity	Thousands of short tons	Capacity owned or leased by private companies	Total capacity
Aluminum Co. of America:						
Mobile, Ala	650	27	27			
East St. Louis, Ill	420	17	17			
Alcoa, Tenn						
Vancouver, Wash						
Massena, N. Y				330	51	37
Badin, N. C						
Niagara Falls, N. Y						
Total	1,070	44	44	330	51	37
Reynolds Metals Co.:						
Hurricane Creek, Ark	778	32	32			
Listerhill, Ala	100	4	4	50	7	6
Troutdale, Oreg				70	11	8
Jones Mills, Ark.[2]				39	6	4
Longview, Wash				31	5	4
Total	878	36	36	190	29	22
Permanente Metals Corp.:						
Baton Rouge, La	500	20	20			
Spokane (Mead), Wash				109	17	13
Tacoma, Wash				20	3	2
Total	500	20	20	129	20	15
Total capacity owned or leased by private companies	2,448	100	100	649	100	74
War Assets Administration:						
Los Angeles (Torrance), Calif.[3]				90		10
Riverbank, Calif.[4]				54		6
Massena (St. Lawrence), N. Y.[5]				54		6
Jones Mills, Ark.[2]				36		4
Total unleased Government capacity [6]				234		26
Total United States	2,448	100	100	883	100	100

[1] Data from WAA First Supplementary Report to Congress on Aluminum Plants and Facilities, Feb. 12, 1947, except for aluminum ingot capacity of Aluminum Co. of America and Reynolds Metals Co. furnished by those respective companies.

[2] Entire plant under lease option to Reynolds Metals Co. Option exercised for one-half only because of power shortage. Option on remainder may be taken up in 1947.

[3] Placed in standby condition in September 1944; now used as a warehouse. Some equipment transferred to Troutdale and Spokane. It was announced in February 1947 that Asarco Aluminum Co. had submitted a bid to operate 32,000 short tons (2 pot lines) of the plant's annual capacity.

[4] Placed in standby condition October 1944. Currently used for storage. Lack of cheap power prevents manufacture of aluminum.

[5] Plant closed October 1944. Some electrical equipment removed to Troutdale and Spokane. Aluminum Co. of America has option to lease and in February 1947 was reported to have submitted a bid to purchase.

[6] In addition there were Government-financed high-cost plants at Queens (Maspeth), N. Y. (144,000 tons) and Burlington, N. J. (54,000 tons), now largely dismantled.

enter into competition were unsuccessful until January 1946, when Alcoa granted royalty-free licenses to use its patented combination process for the treatment of low-grade (high-silica) bauxite. It further agreed to furnish alumina and bauxite, respectively, to Reynolds and to the Permanente Metals Corp., a newcomer in the industry (Olin Corp. withdrew when the Government-owned plants were closed). Between January 4 and August 16 all DPC plants were declared surplus; and by May 29, 1946, the most economic plants, except one, having over 40 percent of the Government total capacity were disposed of to Alcoa competitors, generally on a lease-purchase basis. The accompanying table shows the distribution of both alumina and ingot capacities at the end of 1946.

It is to be noted that there are now three large integrated companies in the field and that Alcoa owns but half of the virgin-metal facilities. There remains, subject to later disposal, about 234,000 tons capacity in modern plants. A fourth company, Asarco Aluminum Co., had made unaccepted offers for alumina and reduction plants and early in 1947 proposed to acquire a part—two potlines—of the Los Angeles (Torrance) DPC plant. A striking element of the accomplished industry redistribution is the geographical transition. Before the war virtually all facilities lay east of the Mississippi. Now approximately 40 percent of metal capacity is concentrated in Washington and Oregon, about 5 percent may be added in California, and about 5 percent is in Arkansas, leaving approximately one-half in its former location. A good share of fabrication has shifted westward, and it is expected that alumina plants will soon show a like trend.

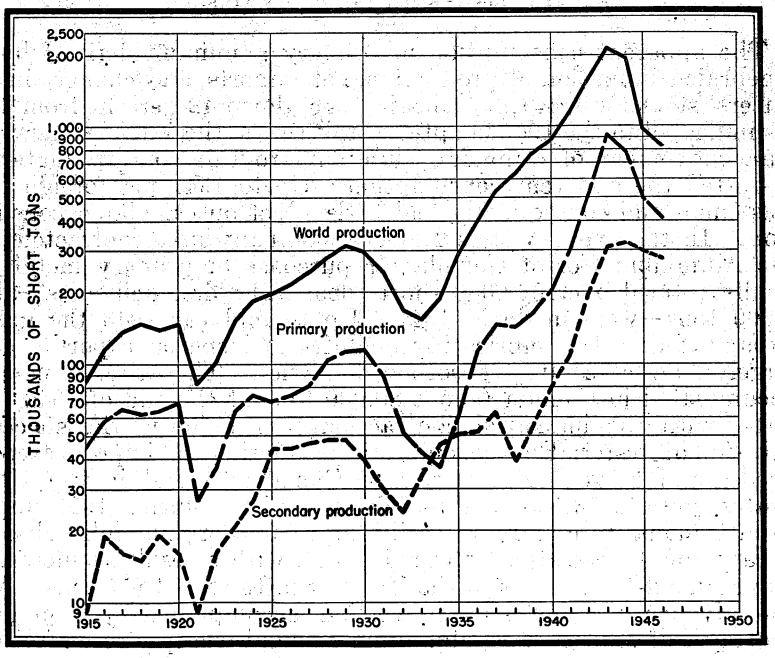

FIGURE 1.—Trends in domestic primary and secondary production and world production of aluminum, 1915–46.

Secondary.[2]—The dearth of primary metal that developed during 1946 markedly influenced secondary operations. Although total recovery of secondary aluminum was 278,073 short tons compared with 298,387 tons in 1945 and the peak output of 325,645 tons in 1944, production of remelt aluminum ingot was large and in October reached a near record level of 21,000 tons. Worthy of note was the exceptionally high ratio of secondary to primary output of about two-thirds, whereas in the 5- and 10-year periods ending with 1939 the ratio was about 40 to 45 percent—a ratio likely again soon to be approached, as the wrecked aircraft and other scrap supply has diminished greatly and other sources of old scrap were well cleaned up during the war.

Recovery comprised 2,075 tons of pure metal (98.5 percent), 274,068 tons in aluminum alloys, 597 tons in brass and bronze, 504 tons in zinc-base alloys, 266 tons in magnesium alloys, and 563 tons in chemical compounds. Secondary ingot production was 207,574 tons compared with 198,426 tons in 1945. Purchased-scrap consumption in 1946 was 344,472 tons, an increase of 6 percent above that in 1945. Of the quantity used, 143,836 tons or 42 percent was old scrap (10 percent in 1945), and 200,636 tons or 58 percent was new scrap (90 percent in 1945). Notable compared with 1945 were declines in consumption of alloy sheet (45,866 tons or 34 percent) and borings and turnings (69,355 tons or 67 percent) and a 563-percent (89,105 tons) rise in aircraft scrap. Remelters, smelters, and refiners used 69 percent of the scrap; primary producers, 29 percent; and foundries and other manufacturers, 2 percent. Additional information is given in the chapter of this volume, Secondary Metals—Nonferrous.

CONSUMPTION AND USES

The apparent consumption of primary aluminum derived by the algebraic summation of production, net imports, and changes in producers' stocks was 461,877 tons in 1946, down 42 percent from 1945. As indicated in the 1945 chapter of this series, the extraordinary wartime movement of Canadian aluminum to this country materially distorted the apparent consumption. Up to 1941 net foreign trade was small and consequently had little effect on calculated consumption. In that year Metals Reserve Company first contracted with the Aluminum Co. of Canada for purchase of primary metal that finally totaled over 680,000 short tons. The first deliveries—about 8,000 tons—were made in 1941. Up to midyear 1943 the greatly expanded domestic fabricating facilities and special export needs—largely lend-lease—fully absorbed deliveries. Thereafter some stock accumulated in Canada (about 80,000 tons at the end of 1943). In 1944, with the industrial contraction that followed the successful invasion of western Europe, domestic production and imports exceeded needs, and Government stocks of Canadian metal in the United States grew to 73,555 tons by the year end. During 1945 imports from Canada were extraordinarily large but were not fully absorbed because of the cessation of war demand, with a resulting increase in Government-held stocks in the United States to 173,857 tons. With the advance in industrial reconversion, accompanied by pronounced shortages of other metals, aluminum demands sharply rose after mid-

[2] All figures for 1946 are preliminary.

year 1946. They were met in part by allocations of 113,990 tons from Government stocks, leaving 71,760 tons for future disposal. The Civilian Production Administration as early as May 1946 reported a civilian deficiency of 35,000 tons and by October estimated it at 190,000 tons, with only about 119,000 tons then available for allocation; hence, it is expected, that the year-end inventory will be depleted early in 1947. If adjustments are made corresponding to the above-named Government stock changes, apparent consumption for 1944–46 would be, respectively, 671,072, 696,918, and 575,687 tons. (See modified curve on accompanying chart.)

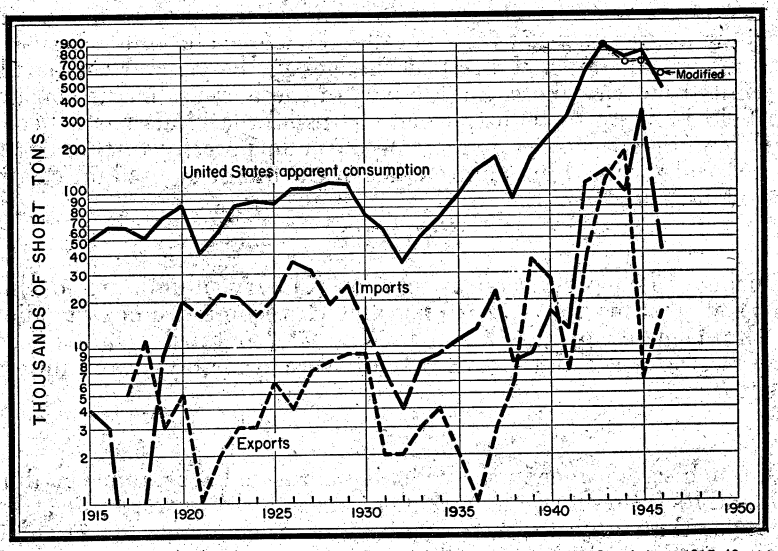

FIGURE 2.—Trends in imports, exports, and apparent consumption of aluminum, 1915–46.

Production, imports, exports, and apparent consumption of primary aluminum and production of secondary aluminum in the United States, 1942–46

Year	Primary aluminum					Secondary aluminum	
	Production		Imports (short tons)	Exports (short tons)	Apparent consumption [1] (short tons)	Short tons	Value [2]
	Short tons	Value					
1942	521,106	$151,371,000	112,112	38,747	588,969	196,464	$57,446,074
1943	920,179	265,380,000	135,581	117,624	877,349	313,961	90,546,352
1944	776,446	222,416,000	100,969	188,108	744,627	325,645	93,264,728
1945	495,060	140,864,000	334,125	5,741	797,220	298,387	85,297,005
1946	409,630	115,812,000	42,607	16,694	461,877	278,073	78,639,044

[1] Data not available on fluctuations in consumers' stocks. Withdrawals from producers' stock totaled 55,320 tons in 1944 and 26,334 in 1946 additions to producers' stocks totaled 5,502 tons in 1942, 60,787 in 1943, and 26,224 in 1945.
[2] Based upon average price of primary aluminum as reported to Bureau of Mines.

During 1946 the consumption pattern of aluminum was indicative of a substantial shift to peacetime from war applications that at their peak were estimated to be about 85 to 90 percent in the field of trans-

port, with the bulk to airplanes. It may be noted, however, that the present pattern reflects an invasion of application fields of competing materials that may be lost in part when they again become freely available. This was marked in home and building construction. The Aluminum Co. of America has compiled, especially for the Bureau of Mines, the following percentage industry distribution of orders for 1946, with comparable immediate prewar period averages [3] shown in parentheses: Transportation (air, land, and water), 9 (29); machinery and electric appliances, 10 (15); cooking utensils, 13 (14); electrical conductors, 8 (10); building construction, 29 (8); foundry and metal working, 19 (4); food and beverage, 3 (6); chemical, 2 (5); ferrous-nonferrous metallurgy, 3 (5); and miscellaneous 4 (4). The foregoing figures may not fully parallel the whole aluminum industry's distribution but do show marked changes in the general use pattern. As pointed out elsewhere, a large part of the increase in the construction field is likely to be lost when the usual materials again become available. That, however, may be offset in part by further growth in electrical uses and by maintenance of the quantity used for castings and extrusions.

STOCKS

During 1946 producers' stocks of primary aluminum declined 26,334 short tons to 14,722 tons, and Government stocks available for allocation dropped 113,990 tons to 71,760 tons. Data on consumers' stocks are not available but were probably near minimum inventories.

PRICES

Of much significance in the widening industrial acceptance of aluminum and its future hold on markets has been its downward price trend. For more than 20 years there has been no price increase. At the beginning of World War II (1939), the base price for 99.0–99.5 percent primary aluminum ingot stood at 20 cents a pound delivered, but four price reductions brought it to 15 cents a pound by October 1, 1941. This became a maximum under the General Maximum Price Regulation of April 1942. It remained effective throughout 1946, although Office of Price Administration had suspended control August 30, 1945. A price differential of 1 cent in favor of pig was set by the principal producer late in 1942. This became the OPA ceiling early in 1943. This price course and current stability stand in marked contrast to the general price level that has risen sharply since 1940 and strikingly so to the trend of other nonferrous metal prices in the latter half of 1946. As regards copper, with which aluminum was increasingly competitive, there was a notable reversal in position when in November, for the first time in history, its pound price exceeded that of aluminum. Up to the time this chapter was prepared—April 1947—the disparity continued to be accentuated. Inasmuch as about half the demand for aluminum is elastic and there is little evidence of an early return to prewar price relationships, aside from other favorable factors, it appears probable that the growth in demand for aluminum may continue to be more rapid than before the war.

[3] See Minerals Yearbook, 1940, Review of 1939, p. 650.

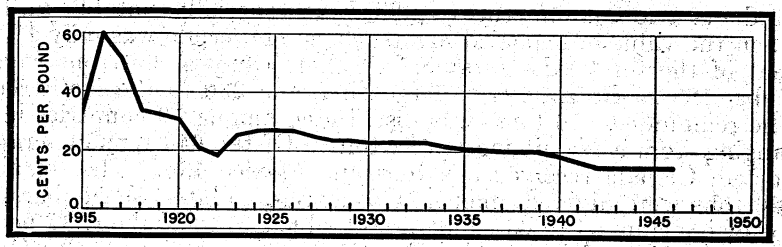

FIGURE 3.—Trend in average quoted prices of aluminum, 1915–46. Price is for No. 1 virgin 98–99 percent at New York through 1929. Thereafter for 99-percent-plus virgin ingot, as reported by American Metal Market.

FOREIGN TRADE [4]

In 1946 foreign trade in aluminum and products approached, but still remained substantially above, the 1935–39 average level. Imports of crude and semicrude metal (excluding scrap) were slightly more than one-eighth the peak receipts of 1945. Canada furnished 41,623 tons, of which about 18,500 tons were for Office of Metals Reserve account, and brought the wartime commitments to an end. The remainder was received from the United Kingdom. Scrap receipts were by far the highest of any year since separate reporting was begun in 1939 and, in fact, exceeded the total imported in 1939–45, Much of the material was wrecked aircraft scrap. Canada was the source of 6,100 tons; the United Kingdom, 6,755 tons; Italy, 1,310 tons; and seven other countries the remainder, 328 tons.

Aluminum imported for consumption in the United States, 1944–46, by classes

Class	1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value
Crude and semicrude:						
Metal and alloys, crude	100,315	$29,736,189	332,437	$96,931,816	41,487	$9,986,327
Scrap	1,784	145,053	5,168	511,824	14,493	1,766,298
Plates, sheets, bars, etc	654	348,740	1,688	846,203	1,120	483,474
	102,753	30,229,982	339,293	98,289,843	57,100	12,236,099
Manufactures:						
Bronze powder and powdered foil	20	16,887	1,884	747,905	5	5,289
Foil less than 0.006 inch thick	31	35,716	100	91,527	57	61,287
Leaf (5½ by 5½ inches)					(1)	641,796
Table, kitchen, hospital utensils, etc	1	2,631	6	13,906	14	47,334
Other manufactures	(2)	37,437	(2)	205,486	(2)	74,447
	(2)	92,671	(2)	1,058,824	(2)	830,153
Grand total	(2)	30,322,653	(2)	99,348,667	(2)	13,066,252

[1] Leaves: 12,735,571; equivalent in pounds not recorded.
[2] Quantity not recorded.

Exports of crude and semicrude aluminum (excluding scrap) were nearly three times as large as in 1945 but were less than one-tenth those of the record year 1944. As usual, much of the imported material, predominantly metal and alloys, reappears for export as mill

[4] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

products and manufactures. This was especially notable in 1946, when the value of exported ingots, slabs, and crude was only 1½ percent of the total export value. Of these exports, 144 tons went to Cuba, 133 to Brazil, 124 to Argentina, and 330 to the Netherlands. The remainder, 376 tons, was distributed among 19 countries in lots ranging from a few pounds to 82 tons. Of the 640 tons of scrap exported, Canada received 379 tons and Mexico 135. The remaining 126 tons were divided among 11 countries. Plates, sheet, bars, and rods were shipped to 63 countries, of which 15 took about 87 percent of the total, as follows: Canada, 1,515 tons; Mexico, 1,038; Guatemala, 698; Honduras, 426; Costa Rica, 697; Cuba, 704; Colombia, 359; Venezuela, 2,600; Peru, 307; Chile, 436; Brazil, 497; Philippine Republic, 2,860; China, 357; British East Africa, 536; and Union of South Africa, 504.

Aluminum exported from the United States, 1944–46, by classes

Class	1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value
Crude and semicrude:						
Ingots, slabs, and crude	133,089	$39,027,310	2,209	$617,588	1,107	$305,072
Scrap	413	54,466	802	102,657	640	120,522
Plates, sheets, bars, etc	55,019	34,496,958	3,532	2,343,995	15,587	9,706,350
	188,521	73,578,734	6,543	3,064,240	17,334	10,131,944
Manufactures:						
Tubes, moldings, or other shapes	5,224	7,999,206	815	640,352	1,338	1,130,786
Table, kitchen, and hospital utensils	25	40,383	177	313,225	1,860	3,419,792
Foil and leaf	1,634	1,411,531	1,306	1,512,419	1,794	1,570,334
Powders and pastes (aluminum and aluminum bronze) (aluminum content)	12,443	5,489,895	4,214	2,065,398	435	473,770
Other manufactures	(1)	1,280,373	(1)	2,270,672	(1)	3,557,427
	(1)	16,221,388	(1)	6,802,066	(1)	10,152,109
Grand total	(1)	89,800,122	(1)	9,866,306	(1)	20,284,053

[1] Quantity not recorded.

INDUSTRIAL DEVELOPMENTS

Much of the technologic progress reported in 1946 was an outgrowth of wartime developments induced by the exacting demands of airplane designers. In general, they related to enhanced mechanical properties and bettered fabrication processes that have furnished materials and techniques adaptable to a broader range of applications than was considered possible a few years ago.

The wider use of continuous-billet casting has made possible the production of larger and stronger rolled, forged, or extruded sections. Die casting expanded at the expense of sand casting, furnishing products to close tolerances that reduced or, in some instances, even eliminated machining. Likewise there was a marked growth in production of extrusions, not only of aluminum alloys but of pure aluminum-clad alloys.

The shortage of the usual materials for building construction, especially for housing, brought forth new composite materials in which

aluminum sheet was the surface element; or, in the form of foil, an insulator. A wide range of decorative or protective coatings—in color and enamel as well as electroplated chrome or nickel—were made available for architectural or structural use. Although developed just before the war, aluminum-coated continuous steel strip was first produced commercially in 1946; the material appears likely to displace galvanized sheet in some uses, such as for ducts. New aluminum paints also appeared, and production of nails grew rapidly. Aluminum electric transmission cable was in strong demand. Aluminum electric wire for house and building installation entered the market, having received Underwriters Laboratories, Inc., approval in September.

In the transportation field aluminum greatly extended its use, especially in marine applications, such as in boats and as superstructure, funnels, lifeboats, ladders, interior trim, and furniture for large vessels. The Aluminum Co. of America had designs made for 7,780 and 10,280-ton all-aluminum bauxite-ore carriers and put into service three medium-size passenger-freight vessels having aluminum upper works. Another striking unique use of the metal was the construction of a 100-foot-span railroad bridge near Massena, N. Y. New bearing alloys suited to high temperatures and heavy pressures were reported, as were high-strength, heat-resistant alloys for use in jet turbine engines. Aluminum-copper-beryllium heat-treatable alloys and similar alloys with cobalt were developed. For secondary metal recovery, the Reynolds Metals Co. developed an improved sloping-hearth furnace capable of taking large airplane wing or body sections and producing high-quality ingot from unsegregated scrap.

WORLD REVIEW [5]

World output in 1946 was about 14 percent below that in 1945 and approximately 40 percent of the peak reached in 1943. In that year the Axis and the Axis-dominated countries accounted for more than a quarter of the world's total—equivalent to roughly two-thirds of the world output in 1946. In 1946 Germany and Japan no longer appeared as primary metal producers and henceforward their share may be fully dissipated, with plant and equipment distributed among the principal victors. A new world-production pattern thus emerged.

For the first time since 1939 close evaluation of world production has been made possible through receipt of official statistics. The revisions shown in the accompanying table show that total output moderately exceeded estimates for the war years, to a large extent attributable to the high production levels attained in the Axis countries.

Australia.—The Australian Aluminum Production Commission in its first report covering a 14 months' survey ended June 30, 1946, concluded that the Commonwealth's resources justified establishment of an aluminum industry. An alumina plant with reduction works is to be erected in Tasmania, according to the Commission. Australian annual postwar aluminum requirements were estimated at 6,000 tons. The proposed plant would have an equal excess capacity.

Austria.—Although a small reduction plant (Swiss-owned) was built at Lend in Upper Austria in 1897 and a second one at Steeg during

[5] Unless otherwise noted, metric tons used throughout this section.

World production of aluminum, 1940–46, by countries, in metric tons

[Compiled by B. B. Mitchell]

	1940	1941	1942	1943	1944	1945	1946
Austria	6,675	21,415	36,797	45,995	52,100	5,250	1,039
Brazil (estimated)						275	250
Canada	99,013	194,021	308,982	449,734	419,176	195,691	175,449
China						(1)	(1)
Formosa (Taiwan) [2]	8,762	12,547	13,498	14,498	9,201	(1)	
Manchuria [2]	5,026	8,031	7,437	[3] 10,000	[3] 8,000	[3] 3,300	(1)
France	61,740	63,915	[3] 45,230	[3] 46,460	[3] 26,150	37,225	47,579
Germany	204,783	212,266	227,131	203,068	191,000	[3] 20,000	
Hungary	3,190	4,980	5,960	9,460	[4] 13,190	[5] 2,300	[6] 687
India			[3] 500	[3] 1,300	[3] 1,600	[3] 1,500	(1)
Italy	38,790	48,195	45,430	[3] 35,000	[3] 45,000	2,584	10,629
Japan [2 3 7]	30,620	56,080	85,211	114,057	88,254	[3] 5,404	
Korea (Chosen) [7]	1,481	3,120	4,366	12,529	12,943	[3] 1,243	
Norway	27,780	17,528	20,498	23,514	20,035	[3] 7,000	16,630
Rumania						(1)	(1)
Spain	1,295	1,120	742	797	206	592	(1)
Sweden (includes alloys)	1,563	1,094	1,294	3,572	3,723	3,236	(1)
Switzerland	28,000	24,200	24,000	[3] 20,000	34,000	(1)	(1)
U. S. S. R.	59,940	[3] 50,000	[3] 55,000	62,340	[3] 71,000	86,310	(1)
United Kingdom	19,264	23,030	47,528	56,557	36,038	32,412	32,051
United States	187,100	280,383	472,737	834,768	704,376	449,109	371,608
Yugoslavia (estimated)	2,000	2,000	2,000	2,000	1,000	(1)	(1)
Total [7]	787,000	1,023,900	1,404,400	1,946,000	1,737,000	887,000	750,000

[1] No data available; estimate included in total.
[2] Fiscal year ended Mar. 31 of year following that stated.
[3] Estimated production.
[4] January to June, inclusive.
[5] June to December, inclusive.
[6] January to May, inclusive.
[7] Preliminary; subject to revision.
[8] April to June, inclusive.

the First World War, their combined capacity was only 4,700 metric tons when Austria was incorporated in the Third German Realm in 1938. Internal demand was never large; and most of the production, which reached a prewar peak of 4,428 tons (1938), was exported mainly to Germany. The period 1939–46 is considered under the section on Germany.

Brazil.—Attempts to develop aluminum-ingot production in Brazil have been unsuccessful so far, although modest mill facilities were expanded during the war. Eletro-Quimica Brasiliera, S. A., near Ouro Preto, Minas Gerais, poured the first South American ingot in March 1945 but ceased operation in 1946. The annual rated capacity was about 2,500 tons, but the maximum production was 3.5 tons a day. The operation was uneconomic because of high capital charges and heavy transport charges on bauxite. It was announced about the year end that Aluminium, Ltd., and Brazilian capitalists had formed a joint enterprise, Aluminio do Brasil, S. A., with assets over $10,000,000. It was proposed to erect an integrated plant with high-speed rolling mill and other equipment at Moze das Cruzes about 90 km. from São Paulo. Brazilian aluminum consumption was about 5,500 tons in 1946 but is expected to reach 15,000 tons in the near future.

Canada.—As in the United States, aluminum production slumped to about 40 percent that of the peak war year, 1943; this, however, was about double the 1939 rate, when then existing facilities were working close to their capacity. In 1946, notwithstanding the strong internal demand, the Aluminum Co. of Canada, Ltd., reported domes-

tic sales of only about 14 percent of its production, leaving about 86 percent for export. This company is reputed to have the world's lowest production costs and through its parent organization, Aluminium, Ltd., has representation or related subsidiaries engaged in various phases of a fully integrated operation in more than 50 countries. It is, consequently, in a highly favorable position with respect to foreign trade, especially within the British Empire. Shipments to the United Kingdom, which, except during the war has been the principal market, were nearly half the year's exports, with about 20 percent to the United States and the remainder to 46 other countries. In the spring of 1946 a contract was made to deliver 215,000 metric tons to Great Britain by the end of 1947. At about the same time the price in Canada was cut to 13.25 cents a pound delivered and though raised in November to 14 cents—partly compensating for the July dollar revaluation—represents a drop of about 30 percent since the beginning of the war despite wage increases of about 50 percent. Considerable plant modernization or expansion was under way during the year, and largely took the form of sheet- and foil-rolling, wire-drawing, and extrusion facilities.

China (Formosa).—The former Japanese plants at Kaohsiung and Hualien were placed under the management of the Taiwan Aluminium Co., an organization set up by the National Resources Commission of China. Both plants were seriously damaged during the war. Cost of rehabilitation is estimated to be US$12,000,000. The first-named plant, erected in 1936, had a capacity of 12,000 tons yearly. Operation ceased in March 1945. The Hualien plant that had a capacity of 8,000 tons annually was closed in August 1944.

France.—Primary metal output rose sharply near midyear and averaged closely 165 tons a month above that of the last prewar year, 1938. Output was hampered, especially in the first quarter, by power shortages and to some extent by limited fuel supply. Exportation was resumed, but the short supply held it in the first 7 months to about 20 percent of the 1938 rate. According to Revue d'Aluminium, the percentage distribution of consumption in 1938 was as follows: Transportation, 59.8 (aircraft alone, 36.3); electrical industry, 18.8; household goods, 10.2; and miscellaneous, 11.2.

Germany.[6]—Except for a small Swiss-owned plant constructed at Rheinfelden, Baden, in 1897, Germany was not an aluminum producer until the First World War. Its early recognition of the value of the light metal in warfare and as a substitute for scarce copper then made it an important factor in world aluminum production. Its real ascendancy began with Hitler's rise to power in 1933. In that year its (Altreich or pre-World War II Germany) virgin aluminum capacity exceeded 47,000 metric tons. Production, greatly affected by the then world-wide depression, was scarcely 19,000 tons; but it was nearly one-half that of the United States and put Germany, with 13 percent of world output, in second place among producing countries. At the outbreak of World War II in September 1939, its productive capacity had risen to 204,000 tons plus 5,000 tons in Austria. Its output in 1939 then reached 195,000 tons, tenfold that of 1933, with

[6] Most of the data have been derived from Economic Survey of Germany, The Metal Industries, prepared by the Economic Advisory Branch, Foreign Office and Ministry of Economic Warfare, London, September 1944, and from German Aluminum and Magnesium Industries, Office of Military Government for Germany U. S.), (FIAT) Final Rept. 501, November 1945.

an added 4,000 tons from former Austria, and with 28 percent of world production (about 710,000 tons) superseded the United States, whose output was only four times that of 1933, as the premier producer. Plant expansion and new construction were continued almost to the end of the war; and near the close of 1944 capacity of Altreich plants was about 256,000 tons, with about 74,000 tons more in former Austria where, at Engerau, a 20,000-ton plant was under construction. Production of virgin metal, however, reached a peak in 1942, comprising 227,000 tons in old Germany and nearly 37,000 tons in the Austrian area, together less than 20 percent of world production. In 1944 Austria's share had increased to 52,000 tons, whereas in Germany proper, as Allied air attacks became more successful, production dropped to 190,000 tons. In the final year of the war, as Germany itself became the battleground, production virtually ceased.

War damage to plants appears to have been moderate; but parts, at least, of some were soon removed, and others are about to be dismantled or distributed as reparations. At the time of the Allied occupation about 45 percent of the capacity was in the Russian zone, 22 percent in the British, about 17 percent in the United States, and 16 percent in the French zones. In the Austrian area all operating plants are in the Western Powers' zones but the partly completed Engerau plant is in the Russian-controlled section. The location, capacities, and peak output, in thousands of metric tons, of the various virgin metal plants are shown in the accompanying listing.

Primary aluminum plants, location, capacities, and peak output in Greater Germany, in thousands of metric tons

Plant and location	Capacity		Maximum reported output and year	Occupation zone
	June 1942	End 1944		
1. Bitterfeld, Saxony	38.4	38.4	38.0 (1941)	Russian.
2. Aken, Saxony	11.0	11.0	11.3 (1943)	Do.
3. Lauta, Saxony	62.8	62.8	56.8 (1941)	Do.
4. Lünen (Lippewerk) Westphalia	32.5	32.5	33.8 (1943)	British.
5. Grevenbroich (Erftwerk)	23.0	23.0	24.2 (1938)	Do.
6. Mundenheim, Palatinate	.5	.5	.4 (1942)	French.
7. Rheinfelden, Baden	29.0	39.0	25.8 (1942)	Do.
8. Töging, Bavaria	45.0	45.0	45.0 (1940)	American.
9. Ranshofen (Mattigwerk) Austria	32.4	64.8	38.0 (1943)	Austrian.
10. Steeg, Austria	2.2	2.2	2.1 (1941)	Do.
11. Lend, Austria	8.0	8.0	7.9 (1942)	Do.
Total Greater Germany	284.8	327.2	264.0 (1942)	

In addition to the foregoing, there were aluminum-silicon alloy plants at Lauta, 3,500 tons (aluminum content), and at Horrem, Westphalia, 2,600 tons. The latter was to have been removed to Schärding, Austria, in 1944. There were 13 large and nearly as many smaller secondary recovery plants, all in the Altreich, whose distribution and approximate capacities in 1944 were as follows: Russian zone, 7 plants (66,000 tons); British zone, 12 (56,000 tons); and United States zone, 5 (22,000 tons). Their prewar (1938) output was about 35,000 tons compard with less than 6,000 tons in 1933 and a maximum of 163,000 tons in 1944. Secondary recovery in Austria was usually negligible but was perhaps 2,500 tons late in the war period.

Primary plants (numbered 3–5 and 8–9 in the accompanying table) having 70 percent of the total capacity in 1944, were owned or operated by the Vereinigte Aluminium Werke (VAW), a concern organized in 1917 with half State and half private capital. Of the others, 1 and 2 were controlled and operated by I. G. Farbenindustrie and 7 by the Swiss Aluminium Industrie, A. G. Of the reclaim works two (27,000 tons) were in the hands of VAW and one (18,000 tons) was owned by I. G. Farben.

In October 1946 it was announced that 85 nonferrous metal plants in Germany proper were approved for reparations by the Allied Control Council in Berlin. Allocation will be made between the Inter-Allied Reparation Agency and the U. S. S. R. Those given the first group will be partitioned between 18 western nations. About 45 of the plants had been partly or fully engaged in the manufacture of alumina, primary and secondary metal, alloys, or wrought and cast products. Primary plants numbered 4–5 and 7–8 are included. Of plant 7, only the part built since 1933 was subject to allocation.

Consumption and other data are given in the accompanying table.[7] Estimated distribution of primary metal consumption, by use, in 1936 was as follows: Transportation, 19 percent; military use, 3 percent; electrical machinery, 7 percent; other machinery, 8 percent; wire and cable, 18 percent; household goods, 7 percent; foil, 9 percent; other fabricators, 12 percent; and miscellaneous, 17 percent. Even roughly comparable figures are not available for the war years. The large proportion going to wire and cable was striking. In 1943–44 it

Aluminum plant capacity, production, and consumption in Greater Germany, 1938–45

[In thousands of metric tons]

	1938	1939	1940	1941	1942	1943	1944	1945
Capacity, primary:								
Altreich [1]	191.4	203.8	218.5	237.5	247.3	258.3	258.3	258.3
Austria	4.7	5.2	18.0	31.8	64.2	75.0	[2] 75.0	[2] 75.0
Total	196.1	209.0	236.5	269.3	311.5	333.3	333.3	333.3
Production, primary:								
Altreich	161.1	195.1	204.8	212.3	227.1	203.6	192.2	[3] 15.6
Austria	4.4	4.3	6.7	21.4	36.8	46.0	52.1	5.2
Total	165.6	199.4	211.5	233.7	263.9	249.6	244.3	(7)
Secondary [4]	34.8	48.4	58.0	85.6	103.2	128.4	163.2	[5] 12.0
Net imports	10.9	4.5	28.2	29.4	7.6	30.5	[6] 77.9	(7)
Consumption: [8]								
Primary	176.6	204.0	256.0	274.8	273.4	248.8	268.5	(7)
Secondary	59.8	(7)	12.1	80.6	91.1	129.0	200.6	(7)
Total	236.4	(7)	268.1	355.4	364.5	377.8	[9] 469.1	(7)

[1] Includes aluminum content of "Silumin" alloy (4.2 in 1938–39, 6.1 thereafter).
[2] Excludes 20,000 tons planned capacity Engerau, Eastern Austria, plant under construction.
[3] January–February only. Later figures not available.
[4] Distribution between Altreich and Austria not available after 1937 but virtually all from Altreich.
[5] Estimated by chapter author.
[6] Partly estimated.
[7] Not available.
[8] Distribution between Altreich and Austria not available after 1937.
[9] Includes exports.

[7] Figures given in the original documents were compiled from various official and industry sources after the war. The several series were not, as pointed out by the authors, always comparable or continuous and showed some simple arithmetical errors and in part contained some estimates. Up to 1942–43 the data were not fully adequate; thereafter an attempt made to standardize and improve statistical procedures removed most of the conflicting series. The reported figures may not be accurate but are believed to be representative. In view thereof and as figures contained herein were taken from numerous original tables, minor discrepancies between text and tables, or therein, remain unreconciled.

accounted for 12 to 14 percent of the primary aluminum used for semimanufactures and between 14 and 19 percent of the total aluminum (primary and secondary) so used. Use or allocations for the armed forces in 1940–43 appear to have been within the range 74 to 81 percent of the total consumption or supply. About 4 to 5 percent was for export and the remainder for civilian use, but much of that indirectly benefitted the military forces.

On the whole, German processing methods did not differ widely from those in use in the United States. There may have been greater relative use of Soderberg electrodes, and continuous billet casting was more widely employed. An interesting alternating use of a wire mill for drawing copper and aluminum was noted. Considerable experimentation on methods of raising the quality of secondary metal recovered from alloy scrap were carried out. The three-layer refining process used at the Grevenbroich plant produced, it was claimed, 90 tons monthly of 99.99 percent aluminum. Similar refining cells were being installed at Ranshofen. Other methods using zinc, mercury, or lead for alloying with the scrap followed by distillation were also tested but were not applied on a commercial scale. In the zinc process the first major separation of the alloy components is accomplished by filtration.

Hungary.—Since Hungary was occupied by Soviet armies and has become, at least de facto, a satellite of the U. S. S. R., information on aluminum production has been scant. For the first 5 months of 1946 production was said to have been 687 tons, compared with a reported bauxite output of 18,000 tons.

India.—The first consequential metal production was in 1943 by the Aluminium Co. of India, Ltd., an associate of the Aluminum Co. of Canada, from the reduction works near Alwaye, Travancore, with rolling mill and fabricating plant at Belur near Calcutta. Capacity was about 1,500 tons yearly and was said to have met India's needs. Consumption has increased greatly, and the plant is to be increased to a 5,000-ton annual level as soon as power is available. Alloys will be made. A wire mill—the first in India—also is to be set up in Travancore. The Aluminium Corp. of India, Ltd., had constructed an alumina plant at Asansol, Bengal, by 1941, but was unable to complete a reduction works owing to the war. It, however, came into operation in 1946 at about a 1,000-ton yearly rate, with further expansion planned.

Italy.—Except for moderate damage to pot lines and electric installations at Porto Marghera (Swiss-owned), Italian metal plants suffered little during the war. The Mori and Bolzano plants of the Montecatini group resumed production, as did the smallest at Borgofranco (Aluminium, Ltd.). Output in 1946 was 8,000 tons, compared with 2,600 tons in 1945.

Japan.—Under current plans aluminum-reduction works in the Japanese home islands having a rated capacity of about 138,000 tons are to be dismantled or distributed among the four major war victors as partial reparations. The ultimate distribution has not been made public. Scrap-treatment plants may be permitted to operate.

Norway.—The Norwegian Parliament decided to complete construction of the aluminum works near Aardal, western Norway, originally undertaken during the war by the Germans. The State

will participate to the extent of 60 percent, with the remainder taken up by private capital. Power is now available. Production costs have been estimated at slightly more than £70 a ton. The initial annual capacity of 12,000 tons, to be operative in 1947, subsequently will be increased to 24,000 tons. This will double Norway's prewar capacity of about 30,000 tons; nearly all will be available for export, as internal consumption is about 4,000 tons. In 1946 exports were approximately 10,500 tons, of which 4,000 tons went to France, 2,200 tons to the United Kingdom, and 1,900 tons to Denmark.

U. S. S. R.—Press reports state that the aluminum industry is expanding rapidly in the Urals. Sections of the Bogoslovsk plant are in operation, and by 1950 it is scheduled to produce one and a half times as much as the whole country's prewar output. The Volkhov Aluminium Zavod has resumed production, but present capacity is believed to be not more than half that of the prewar figure of about 15,000 tons. Considerable progress also has been made in rehabilitating power sources damaged or destroyed during the war.

United Kingdom.—Consumption of aluminum in 1946 set a new peacetime record, roughly 20 percent above that of 1945 and (for primary metal) 265 percent of the 1938 use. The major shortage was in rolled products, largely induced by the allocation to the extensive Government-fostered aluminum house-building program. In this industry phase, sheet and strip production exceeded the peak wartime rates, 40 percent going to housing. In 1945 orders for 54,000 temporary aluminum houses were placed with five former aircraft manufacturers. The program was slow in getting under way, but by late November 10,000 had been erected. Production rate was then about 500 weekly and was expected to reach 1,200 in February 1947. About 2.6 tons of aluminum, much of it secondary, are required per house, and the present cost is £1,365; both elements are substantially above original estimates. The Government now proposes to extend the application to permanent two-story residences, prototypes of which have been erected, and to schools.

Although the Ministry of Supply lifted controls on purchase and consumption of aluminum and light alloys as of August 1, 1946, it remained the sole distributor of virgin metal. Price changes by the Ministry have occasioned considerable comment. Reflecting the cost of Canadian aluminum purchased in 1945, the British price was cut to £85 a long ton (15.27 cents a pound). According to an official statement, sales at that price involved a loss to the Treasury, as it was below cost of purchases under earlier arrangements and the price then paid for British supplies. In April 1946, after the new Canadian contract was made, the price was dropped to £67 (12.04 cents a pound), which was raised to £72¾ (13.09 cents) in September, corresponding to the upward revaluation of the Canadian dollar. The Ministry admitted that this was considerably below the cost of domestic metal. It was estimated that, at the 1946 production level, the subsidy to the domestic producers was £500,000 or more (about 2.7 cents a pound).

In 1946 primary production was 32,051 metric tons and secondary 49,370 tons. Approximate consumption of virgin metal was 120,900 tons and of secondary 39,600 tons.

Antimony

By RICHARD H. MOTE

GENERAL SUMMARY

THE DOMESTIC antimony industry in 1946 was characterized by a marked upturn in prices during the latter part of the year and a general decline in new supplies. The price of domestic antimony metal in less than carlots remained at 15.84 cents a pound until the removal of Office of Price Administration ceilings November 9, after which the price rose to 29.62 cents in two successive increases. Imports of antimony ore slumped 60 percent to the lowest level since 1935, owing to exhaustion of U. S. Government-owned stocks in South America accumulated during the war years. A threefold increase in metal imports and a 30-percent rise in the over-all antimony content of domestic ore production failed to offset the drop in ore imports. As a result, private and Government stocks were drawn upon to meet consumer demands. At the end of 1946 stocks of antimony ores and concentrates held by smelters and manufacturers were up slightly; but both Government and mine stocks had dropped precipitously, making a net stock decline of 37 percent from the end of 1945. Domestic consumption of primary antimony dropped 32 percent in 1946.

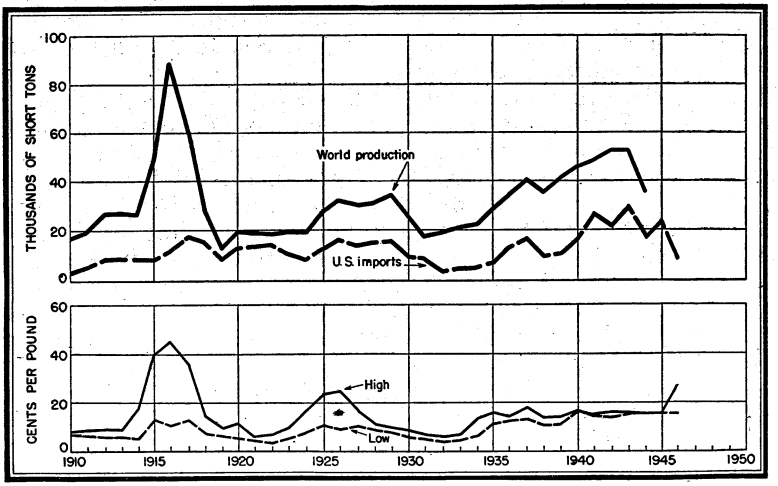

FIGURE 1.—Trends in world production, 1910–44, and United States imports and range in New York price of antimony, 1910–46.

Salient statistics for antimony in the United States, 1942–46

	1942	1943	1944	1945	1946
Production of primary antimony:					
Mine (antimony content)—short tons	2,944	5,556	4,735	1,930	2,505
Smelter (antimony content)—do	(1)	20,624	20,000	21,000	12,457
Production of antimony at secondary smelters—short tons	18,200	15,483	15,886	17,148	19,115
Imports for consumption:					
Antimony in ore—do	20,946	28,755	17,080	22,643	5,903
Needle or liquated antimony—do	522	1			
Metal—do	127	932	293	627	2,593
Exports of antimony ore, metal, and compounds—short tons	230	494	1,319	333	462
Consumption of primary antimony—do	[2] 23,852	19,508	23,756	25,761	17,515
Average price of antimony at New York: [3]					
Chinese (nominal)—cents per pound	16.50	16.50	16.50	16.50	16.50
American—do	15.55	15.92	15.84	15.84	17.31
World production (estimated)—short tons	54,900	55,000	37,800	29,200	27,400

[1] Figure not available.
[2] Primary antimony available for consumption; data not strictly comparable with figures for subsequent years.
[3] American Metal Market.

Antimony remained one of the few metals under Government allocation, as the provisions of War Production Board General Preference Order M–112 were continued through 1946. Details of Order M–112 and amendments can be found in the Antimony chapters of Minerals Yearbook, 1942 through 1945.

DOMESTIC PRODUCTION

MINE PRODUCTION

Six mines are known to have produced ores in 1946 from which antimony was recovered compared with 8 in 1945 and 11 in 1944. Although the production of ore and concentrates dropped 7 percent to 13,962 tons, the antimony content increased 30 percent above the 1945 level. Only 42 tons or 2 percent of the antimony content of all ores and concentrates produced in 1946 were from ores mined solely for antimony, the remainder being contained in ores mined partly for other metals.

Antimony-bearing ores and concentrates produced in the United States, 1942–46, in short tons

Year	Gross weight	Antimony content		Year	Gross weight	Antimony content	
		Quantity	Average percent			Quantity	Average percent
1942	6,980	2,944	42.2	1945	14,966	1,930	12.9
1943	16,785	5,556	33.1	1946	13,962	2,505	17.9
1944	13,501	4,735	35.1				

Idaho.—The mines of Shoshone and Valley Counties yielded 98 percent of the total domestic mine output of antimony in 1946. The Yellow Pine mine of the Bradley Mining Co. in Valley County, by far the most important producer, recovered antimony from a low-grade antimony-gold ore assaying 1.25 percent antimony and 0.08 ounce gold and 0.6 ounce silver per short ton. During 1946 the Yellow

Pine flotation mill was modernized—including the installation of a 300-ton-per-hour crushing plant—and converted from tungsten-ore milling to antimony-gold-ore milling. Mill capacity at the end of 1946 was approximately 2,400 tons of ore per day. Other Idaho antimony producers in 1946 were the Sunshine Mining Co. Sunshine mine and the Coeur d'Alene Mines Corp. Mineral Point mine, both in Shoshone County.

Nevada.—Tony Romano shipped antimony ore to a smelter from his mine in Lander County during 1946.

Oregon.—S. J. and E. P. Merrick operated their Jay Bird mine in Jackson County and produced 10 tons of ore containing about 50 percent antimony.

Washington.—Zenith Mines, Inc., shipped several cars of antimony ore to Midvale, Utah, from its mine in Stevens County.

SMELTER PRODUCTION

Primary.—In 1946 primary antimony smelters consumed 13,029 tons of antimony in raw materials, including 12,801 tons in ores and concentrates, and produced antimony metal, oxide, and sulfide containing 12,457 tons of antimony, a decline of 41 percent from 1945. The Bureau of Mines is not at liberty to publish individual statistics on these three intermediate primary products.

Ores and concentrates consumed at smelters and manufacturers' plants in 1946 contained 17,685 short tons of antimony—4,164 in sulfide concentrates, 3,886 in metallurgical-grade sulfide ore, 3,656 in chemical-grade sulfide ore, and 5,979 in mixed or oxide ore.

Antimony metal, alloys, and compounds produced in the United States, 1942–46, in short tons

Year	Primary metal, oxide, and sulfide (antimony content)	Antimonial lead produced at primary lead refineries						Alloys (antimony content) produced at secondary smelters and by remelters
		Gross weight	Antimony content					
			From domestic ores [1]	From foreign ores [2]	From scrap	Total		
						Quantity	Percent	
1942	[3]	51,762	2,396	871	257	3,524	6.8	18,200
1943	20,624	63,515	1,591	494	1,286	3,371	5.3	15,483
1944	20,000	57,902	2,015	842	1,813	4,670	8.1	15,886
1945	21,000	56,495	1,749	243	2,156	4,148	7.3	17,148
1946	12,457	50,480	1,231	226	1,828	3,285	6.5	19,115

[1] Includes primary residues and small quantity of antimony ore.
[2] Includes foreign base bullion and small quantity of foreign antimony ore.
[3] Figure not available for publication.

The Texas Mining & Smelting Co., Laredo, Tex., continued to be the principal producer of antimony in the United States. The Texas plant, which operates almost exclusively on oxide and mixed oxide-sulfide ores imported from Mexico, was purchased on December 31, 1946, by the National Lead Co.

Harshaw Chemical Co. continued to produce oxide and metal at its El Segundo, Calif., plant. During 1946 the capacity of the smelter

was increased to 1,000 tons of antimony concentrates (50-percent grade) per month.

Production of antimonial lead in 1946 at domestic primary lead refineries declined 11 percent from the 1945 output. The 1946 production contained 3,285 tons (6.5 percent) of antimony derived as follows: From domestic ores 37 percent, from foreign ores 7 percent, and from scrap 56 percent. A detailed discussion of antimonial lead production is contained in the Lead chapter of this volume.

Secondary.—Recovery of antimony in antimonial lead and other alloys from scrap at secondary smelters and by remelters in 1946 totaled 19,115 tons, an increase of 11 percent over the 17,148 tons similarly recovered in 1945. Plates, grids, and sludge from discarded storage batteries continued to be the main source of secondary antimony. A detailed review is contained in the Secondary Metals—Nonferrous chapter of this volume.

CONSUMPTION AND USES

Primary antimony consumed in the manufacture of metallic products declined 7 percent in 1946, whereas the quantity used for nonmetallic products dropped 56 percent, thus markedly changing the use pattern of approximately equal consumption in these categories that existed during the war years. Cancellation of Government war contracts for flameproofed textiles was largely responsible for the sharp decline in antimony consumption in nonmetallic products. Antimony used in the production of porcelain enamel frits and sodium antimonate was approximately double the quantity consumed in 1945. The use of antimony in type metal and solder continued to increase during 1946.

Industrial consumption of primary antimony, 1943–46, in short tons [1]

Product	1943	1944	1945	1946
Metal products:				
Antimonial lead	2,889	5,287	5,920	4,827
Bearing metal	1,563	2,637	2,825	2,886
Battery metal	2,400	2,341	1,273	1,084
Type metal	856	841	1,243	1,903
Cable covering	447	422	275	79
Sheet and pipe	176	326	368	218
Castings	198	115	267	233
Collapsible tubes and foil	132	114	203	121
Ammunition	389	93	107	30
Solder	129	71	125	281
Total metal products	9,179	12,247	12,606	11,662
Nonmetal products:				
Flameproofed textiles	6,952	7,063	7,675	97
Paints and lacquers	1,859	2,490	3,062	1,662
Frits and ceramic enamels	281	501	936	1,814
Glass and pottery	537	411	304	351
Sodium antimonate	47	369	512	1,358
Antimony trichloride	153	289	207	106
Ammunition primers	97	43	66	15
Matches	18	10	18	25
Other	385	333	375	425
Total nonmetal products	10,329	11,509	13,155	5,853
Grand total	19,508	23,756	25,761	17,515

[1] Compiled from monthly applications filed with War Production Board and Civilian Production Administration by approximately 400 consumers requesting allocation of antimony raw materials.

STOCKS

Stocks of the antimony raw materials—ores, concentrates, metal, oxide, and sulfides—held as mine stocks, by industry, and in Government stock piles declined 37 percent from 21,958 to 13,943 short tons of contained antimony.

Stocks of antimony in ores and concentrates held by smelters and manufacturers on December 31, 1946, were 21 percent greater than at the end of the previous year. Government stocks and mine stocks, however, decreased 78 and 96 percent, respectively. Antimony content of oxide on hand decreased 17 percent.

Stocks of primary and intermediate raw materials in the United States at year end, 1945–46, in short tons of contained antimony

Raw materials	Dec. 31, 1945				Dec. 31, 1946			
	Industry	Government	Mine	Total	Industry	Government	Mine	Total
Ores and concentrates	4,246	7,592	3,364	15,202	5,139	1,703	146	6,988
Metallic antimony	1,636	2,554	-------	4,190	1,975	2,929	-------	4,904
Antimony oxide	2,277	91	-------	2,368	1,967	-------	-------	1,967
Antimony sulfide (needle and precipitate)	198	-------	-------	198	84	-------	-------	84
	8,357	10,237	3,364	21,958	9,165	4,632	146	13,943

Antimony ores and concentrates stocked at smelters and manufacturers' plants at end of year, 1942–46, in short tons of contained antimony

Ore and concentrates	1942	1943	1944	1945	1946
Chemical-grade sulfide ore	860	338	794	935	373
Metallurgical-grade sulfide ore	763	415	405	907	1,147
Mixed or oxide ore	1,139	920	990	500	407
Sulfide concentrates	[1] 1,128	1,484	855	1,904	3,212
	3,890	3,157	3,044	4,246	5,139

[1] Includes 50 tons in tetrahedrite concentrates.

PRICES

The Office of Price Administration New York price of domestic brands of antimony, 99.5 percent minimum, in less than carlots remained at 15.84 cents a pound until the removal of ceiling prices November 9. On November 12 the quotations jumped to 24.88 cents, and on December 17 the price advanced to 29.62 cents. Likewise the price of domestic metal in bulk, f. o. b. Laredo, Tex., rose from 14.50 cents to 23.50 cents per pound on November 12 and again on December 17 to 28.25 cents. The London price of metal, 99 percent minimum, remained at £105 a long ton.

Average monthly quoted prices of antimony, prompt delivery at New York for less than carlots, 1942–46, in cents per pound

Month	Chinese brands (duty paid)[1]					American brands[2]				
	1942	1943	1944	1945	1946	1942	1943	1944	1945	1946
January	16.50	16.50	16.50	16.50	16.50	14.00	16.05	15.84	15.84	15.79
February	16.50	16.50	16.50	16.50	16.50	14.00	16.05	15.84	15.84	15.79
March	16.50	16.50	16.50	16.50	16.50	14.62	16.05	15.84	15.84	15.79
April	16.50	16.50	16.50	16.50	16.50	15.90	16.05	15.84	15.84	15.79
May	16.50	16.50	16.50	16.50	16.50	16.01	15.94	15.84	15.84	15.79
June	16.50	16.50	16.50	16.50	16.50	16.01	15.84	15.84	15.84	15.79
July	16.50	16.50	16.50	16.50	16.50	16.01	15.84	15.84	15.84	15.87
August	16.50	16.50	16.50	16.50	16.50	16.01	15.84	15.84	15.84	15.87
September	16.50	16.50	16.50	16.50	16.50	16.01	15.84	15.84	15.84	15.87
October	16.50	16.50	16.50	16.50	16.50	16.01	15.84	15.84	15.84	15.87
November	16.50	16.50	16.50	16.50	16.50	16.01	15.84	15.84	15.84	22.37
December	16.50	16.50	16.50	16.50	16.50	16.02	15.84	15.84	15.84	27.14
Average	16.50	16.50	16.50	16.50	16.50	15.55	15.92	15.84	15.84	17.31

[1] From American Metal Market, nominal.
[2] Metal Statistics, 1947, p. 577.

Quotations for antimony ores and concentrates, according to E&MJ Metal and Mineral Markets, remained at $2.10 to $2.20 a short-ton unit for the 50- to 55-percent grade; $2.15 to $2.20 for 58 to 60 percent; and $2.20 to $2.30 for 60 to 65 percent until November, after which the prices advanced in two successive increases to $3.60 to $3.80, $3.80 to $4.15, and $4.00 to $4.35 for the respective grades at the end of the year. The London price for 60-percent sulfide ore, which was 13s. 6d. a long-ton unit at the beginning of the year, rose to 15s. 6d. in May and closed at 17s. 6d. following a further advance in September.

FOREIGN TRADE[1]

Imports of antimony ore declined 60 percent in 1946 to the lowest level since 1935. Antimony metal imports, however, were the largest since the record year 1941 and 314 percent greater than in 1945.

Antimony imported for consumption in the United States, 1942–46

Year	Antimony ore			Needle or liquated antimony		Antimony metal		Type metal and antimonial lead[1]	Antimony oxides and other compounds	
	Short tons	Antimony content		Short tons	Value	Short tons	Value	Short tons	Short tons	Value
		Short tons	Value							
1942	50,033	20,946	$3,943,402	522	$101,164	127	$28,904	35	(2)	$5
1943	63,187	28,755	5,360,852	1	172	932	267,916	281	(2)	3
1944	41,879	17,080	2,721,690	------	------	293	105,667	388	------	------
1945	49,385	22,643	4,644,859	------	------	627	181,559	1,379	------	------
1946	19,741	5,903	1,323,903	------	------	2,593	824,698	246	------	------

[1] Estimated antimony content; for gross weight and value, see Lead chapter of this volume.
[2] Less than 1 ton.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Antimony imported into the United States, 1945–46, by countries [1]

Country	Antimony ore			Antimony metal	
	Gross weight (short tons)	Antimony content		Short tons	Value
		Short tons	Value		
1945					
Bolivia [2]	18,970	11,348	$2,292,401		
Chile [2]	2,503	1,564	313,141		
China				571	$168,228
Honduras	31	17	3,676		
Mexico	25,146	8,303	1,779,770		
Peru [2]	2,781	1,443	240,088	56	13,329
Union of South Africa	112	61	11,960		
	49,543	22,736	4,641,036	627	181,557
1946					
Bolivia [2]	1,237	758	194,243		
Chile [2]	63	39	705		
China				1,720	587,401
Honduras	14	8	1,272		
Japan				873	237,297
Mexico	18,306	5,031	1,114,783		
Peru [2]	93	48	8,040		
Siam	31	21	5,074		
	19,744	5,905	1,324,117	2,593	824,698

[1] Data include antimony imported for immediate consumption plus material entering the country under bond.
[2] Imports shown from Chile probably mined in Bolivia or Peru and shipped from a port in Chile.

The gross weight of domestic antimony materials exported in 1946 was 462 tons, of which 3 tons were ores and concentrates and 459 tons metal and alloys.

Reexports of foreign materials included 139 tons of metal and alloys (gross weight) and 16 tons of ores and concentrates.

Foreign antimony (regulus or metal) exported from the United States, 1942–46

Year	Short tons	Value	Year	Short tons	Value
1942	(1)	$181	1945	463	$141,301
1943	(1)	200	1946	139	43,197
1944	18	5,445			

[1] Less than 1 ton.

WORLD REVIEW

World production of antimony in recent years, insofar as data are available, is shown in the accompanying table.

World production of antimony, 1939–46, by countries, in metric tons [1]

[Compiled by B. B. Mitchell]

Country	1939	1940	1941	1942	1943	1944	1945	1946
North America:								
Canada	[2] 550	1,083	1,329	1,269	465	809	696	286
Honduras	-------	[3]	23	103	110	65	11	8
Mexico [4]	7,243	11,286	10,241	10,759	12,585	10,056	8,053	6,046
United States	328	412	1,013	2,457	4,638	3,952	1,611	2,091
South America:								
Argentina	97	91	123	41	100	65	[3]	[3]
Bolivia (exports)	9,255	10,813	13,680	16,231	16,536	6,852	5,093	6,407
Peru	775	809	1,440	1,457	2,472	932	2,041	969
Europe:								
Austria	102	184	26	391	571	658	132	15
Czechoslovakia	[2] 1,012	[2] 1,104	1,645	[2] 3,130	[3]	[3]	[3]	[3]
France	-------	-------	-------	128	153	116	143	[3]
Greece	1	[3]	[3]	[2]	[3]	[3]	[3]	[3]
Hungary [2 5]	750	3,100	3,000	2,200	1,500	[3]	[3]	[3]
Italy	674	630	819	667	[3]	[3]	270	[3]
Portugal	174	247	46	[3]	[2] 115	[2] 39	6	5
Spain	22	3	101	210	176	128	108	[3]
Yugoslavia	3,337	[2] 4,800	[3]	[3]	[3]	[3]	[3]	[3]
Asia:								
Borneo, British	14	41	[3]	[3]	[3]	[3]	[3]	[3]
China [6]	12,017	8,469	7,989	3,510	428	[7] 596	-------	[3]
Indochina	22	10	4	1	11	25	[3]	[3]
Iran [8]	[3]	[3]	1	19	[3]	18	2	[3]
Japan	[9] 140	[9] 105	[9] 95	[9] 101	[9] 280	[9] 423	[10] 75	49
Korea (Chosen)	26	21	[3]	[3]	[3]	[3]	[3]	[3]
Turkey (Asia Minor)	460	128	5	600	8	58	40	57
Africa:								
Algeria	216	270	397	304	902	170	86	-------
Morocco:								
French	460	469	184	322	409	166	294	260
Spanish	54	67	85	144	153	72	52	[3]
South Rhodesia	50	101	83	169	164	116	29	16
Union of South Africa	6	126	445	990	1,560	2,570	2,250	2,330
Oceania:								
Australia	419	404	1,052	1,042	532	454	172	[3]
New Zealand	-------	1	8	[3]	-------	-------	-------	-------
Total [11]	38,200	44,800	47,300	49,800	49,900	34,300	26,500	24,900

[1] Approximate recoverable metal content of ore produced, exclusive of antimonial lead ores; 92 percent of reported gross content is used as basis for calculations in nearly every instance. Burma produces antimony, but data on production are not available.
[2] Estimate.
[3] Data not available; estimate included in total.
[4] Includes antimony content of antimonial lead.
[5] Includes Northern Territories and Sub-Carpathia; in addition beginning in 1941 includes Eastern Hungary and Transylvania; and beginning in 1942 includes Southern Territories.
[6] Data represents areas designated as Free China during the period of Japanese occupation.
[7] January to June, inclusive.
[8] Fiscal year ended Mar. 20 of year stated.
[9] Preliminary data for fiscal year ended Mar. 31 of year following that stated.
[10] April to September, inclusive.
[11] Estimated by the author of chapter.

Bolivia.—Total exports of antimony concentrates from Bolivia in 1946 were 7,676 metric tons compared with 6,102 tons in 1945.

China.—Data on antimony production in China are withheld under strict Government control of the industry. Output is believed, however, to have increased sharply under the impetus of Government subsidies. A recent report on the mineral resources of China [2] estimates Chinese antimony reserves as follows:

Province:	*Antimony metal (metric tons)*
Hunan	3,723,040
Kueichow, Kwangsi, Kwangtung, Yunnan, and Anhui	500,000
Total	4,223,040

[2] Juan, Vei Chow, Mineral Resources of China: Econ. Geol., vol. 41, No. 4, pt. 2, June-July, 1946, pp. 444–447.

France.—All antimony ores obtained from French mines in 1946 were used in the manufacture of antimony oxide. About one-half the domestic demand for antimony metal was met by imports, and the remainder of the metal used was smelted from ores imported from Algeria and French Morocco.

Honduras.—The El Quetzal mine near San Augustin de Copan, which shipped antimony to the United States during the war, ceased production in September 1946 because of high transportation costs.

A shipment of 15 long tons of antimony ore assaying 64.95 percent antimony is reported to have been made late in 1946 from a claim near La Union, Department of Olancho.

Spanish Morocco.—Cia. Espanola de Beni—Mesala produced 110 metric tons of antimony concentrates during the first half of 1946, all of which were exported to Spain for treatment.

Turkey.—Antimony concentrates produced in 1946 totaled 123 metric tons (containing an estimated 50 percent antimony).

Union of South Africa.—During the first 9 months of 1946, a total of 3,428 short tons of antimony concentrates was produced, and virtually all was exported.

United Kingdom.—During 1946 the United Kingdom imported 10,474 long tons of antimony concentrates. Domestic consumption of antimony metal totaled 5,623 tons, of which 1,300 tons were used in battery manufacture, 438 tons in other antimonial lead alloys, 646 tons in bearings, 2,590 tons in oxides and compounds, and 649 tons in miscellaneous uses. Consumption of antimony metal scrap totaled 3,199 tons, 64 percent of which was used in antimonial alloys.

Arsenic

By RICHARD H. MOTE

GENERAL SUMMARY

PRODUCTION of white arsenic in the United States declined to the lowest level in 20 years, principally the result of prolonged labor strikes at nonferrous smelters where virtually all domestic arsenic is recovered as a byproduct. Imports of white arsenic and metallic arsenic increased 5 and 79 percent, respectively, but did not offset the sharp drop in domestic output. Thus, in order to meet the consumer demand, industry stocks were reduced by 80 percent and Government stocks of nearly 2,000 short tons were entirely consumed by the end of March 1946. Heavy infestations of cotton-leaf worms, white-fringed beetles, and soybean caterpillars created a demand for calcium arsenate insecticide substantially in excess of supply. A similar supply problem in lead arsenate insecticides would have occurred had not the demand been materially reduced by killing spring frosts, which caused widespread damage to the domestic fruit crops. Price ceilings on white arsenic and arsenicals were removed in mid-1946, and quotations on all compounds had increased by the end of the year.

Salient statistics for white arsenic in the United States, 1942–46

	1942	1943	1944	1945	1946
Production.....short tons..	28,681	31,202	36,094	24,349	10,211
Imports for consumption.....do....	16,350	16,112	9,965	13,149	13,822
Exports.....do....	[1] 305	1,975	2,401	858	[2]
Consumption.....do....	41,520	51,083	43,500	[3] 38,100	[4] 27,800
Price per pound, end of year.....	$0.04	$0.04	$0.04	$0.04	$0.06

[1] Exports by producers only.
[2] Data not available.
[3] Apparent consumption.
[4] Producers' shipments, shipments from Government stocks, plus imports. Total not comparable with 1945.

DOMESTIC PRODUCTION

The domestic arsenic output is largely a byproduct of the smelting and refining of complex copper and lead ores, and the quantity of arsenic produced is directly related to the outputs of these metals. Of the five smelters that recovered byproduct white arsenic during 1946, four were closed by labor strikes during most of the first half of the year; as a result, domestic production slumped 58 percent below the 1945 output to the lowest level since 1926. Producers of arsenic in 1946 included the American Smelting & Refining Co. at Tacoma, Wash., El Paso, Tex., and Murray, Utah; Anaconda Copper Mining Co. at Anaconda, Mont.; and the United States Smelting, Refining &

Mining Co. at Midvale, Utah. No white arsenic was produced by Jardine Mining Co., Jardine, Mont., from its arsenic-gold-tungsten ores in 1946, but a stock pile of several hundred tons of material averaging about 75 percent As_2O_3 remained on hand during the year. Sodium arsenite solution for weed killer was produced directly from Canadian cobalt-nickel concentrates by the Shepherd Chemical Co., Cincinnati, Ohio.

White arsenic produced and sold by producers in the United States, 1942–46

Year	Crude			Refined			Total		
	Production (short tons) [1]	Sales		Production (short tons)	Sales		Production (short tons)	Sales	
		Short tons	Value [2]		Short tons	Value [2]		Short tons	Value [2]
1942	25,658	27,981	$1,198,424	3,023	3,057	$161,942	28,681	31,038	$1,360,366
1943	26,269	27,588	1,251,790	4,933	4,835	267,916	31,202	32,423	1,519,706
1944	31,182	29,159	1,370,602	4,912	5,313	326,217	36,094	34,472	1,696,819
1945	21,358	22,180	1,041,614	2,991	2,630	155,447	24,349	24,810	1,197,061
1946	8,981	10,885	581,328	1,230	1,591	97,091	10,211	12,476	678,419

[1] Excludes crude consumed in making refined. Includes crude white arsenic equivalent of compounds made directly from ores, flue dust, and speiss as follows: 1942, 290 tons; 1943, 172 tons; 1944, 443 tons; 1945, 112 tons; 1946, 180 tons.
[2] Partly estimated.

CONSUMPTION AND USES

Apparent consumption of white arsenic in the United States in 1946 was approximately one-third less than in 1945. More than half of the arsenic consumed is utilized in insect-pest control of food and fiber crops. Lead arsenate is used primarily to protect apple trees against the codling moth and other fruit orchards, home gardens, and ornamental trees against various chewing insects. Calcium arsenate is utilized principally to combat the boll weevil in cotton fields, but a little is used with paris green in controlling potato bugs and cabbage "worms."

Data are not available on the total domestic consumption of the various arsenic insecticides and fungicides in 1946. The general demand for these products greatly exceeded the available supply, however. Although the boll-weevil infestation in the cotton-growing areas of the Southern States was not as severe as in former years, the abundance of other cotton insects, such as cotton-leaf worms and white-fringed beetles, created a demand for calcium arsenate that exhausted farmers' and dealers' stocks. The critical supply situation was partly relieved by the transfer of calcium arsenate stocks in the Northern States to the infested cotton areas. Calcium arsenate was extensively used in 1946 for the control of soybean caterpillars.

Lead arsenate requirements for the fruit industry in 1946 were below normal, due in part to the increasing use of DDT as a substitute for lead arsenate and in part to the widespread killing frosts in the late spring, which prevented fruit crops from ripening and thus eliminated the necessity of pest control during the 1946 growing season.

A new British insecticide, benzine hexachloride, according to American field tests,[1] is more effective than calcium arsenate in the

[1] Science News Letter, vol. 49, No. 13, Mar. 30, 1946, p. 203.

control of cotton boll weevil. Results of the tests suggested, however, that benzine hexachloride is not as effective as calcium arsenate or DDT for the control of bollworms.

Sizable quantities of arsenic are utilized in the preparation of weed killers, large quantities of which are used on railroad rights-of-way. Organic compounds are competitive when selective weed killing is required.

Arsenic is also used in the manufacture of glass, lead-base alloys, dyestuffs, cattle and sheep dips, wood preservatives, and poison bait and in the Thylox purification of industrial gases. Demand for arsenical pharmaceuticals has declined with the advent of the penicillin treatment for venereal diseases. A new arsenical drug, p-arsenosophenylbutyric acid, has been developed for use in curing African sleeping sickness.[2] Early cases of the disease have been reportedly cured in 1 week of treatment. Flexible telephone cables made of an improved arsenical lead alloy containing small quantities of tin and bismuth were introduced for general use in 1946.[3]

Production of arsenical insecticides, consumption of arsenical wood preservatives, and production of arsenical drugs in the United States, 1942–46

Year	Production of insecticides (short tons) [1]			Consumption of wood preservatives (pounds) [2]		Production of drugs (pounds) [3]
	Lead arsenate (acid and basic)	Calcium arsenate (100 percent $Ca_3(AsO_4)_2$)	Paris green (cupric acetoarsenite)	Wolman salts (25 percent sodium arsenate)	Zinc metaarsenite	
1942	31,789	38,898	[4] 2,000	1,307,830	239,786	66,753
1943	40,478	34,932	1,944	769,316	53,516	83,026
1944	45,352	22,154	2,265	782,256	11,503	100,190
1945	35,596	13,356	1,950	732,154	17,980	[5] 36,759
1946	27,907	17,630	([6])	([6])	([6])	([6])

[1] Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce.
[2] Forest Service, U. S. Department of Agriculture.
[3] War Production Board.
[4] Estimated.
[5] January to June, inclusive.
[6] Data not available.

STOCKS

The last of the Government stocks of arsenic and unprocessed material were disposed of in March 1946. Stocks of white arsenic held by producers dropped 80 percent during the year; and stocks of arsenates, particularly calcium arsenate and paris green, are believed to have declined similarly.

PRICES

The quoted price for white arsenic, according to Oil, Paint, and Drug Reporter, remained at 4 cents a pound until Government control of prices was relinquished in midyear, after which the price increased to 5 cents in August and again to 6 cents in early December. Price ceilings were removed from lead arsenate and other arsenicals in July. Increases in quotations from midyear to year end were as follows (cents per pound in carlots): Calcium arsenate, 7 to 8½; lead arsenate, 11 to 17½; and paris green 20 to 26.

[2] Science News Letter, vol. 50, No. 7, Aug. 17, 1946, p. 101.
[3] Science News Letter, vol. 50, No. 3, July 20, 1946, p. 40.

Producers and Government year-end stocks of arsenic compounds in the United States, 1942–46, in short tons

End of year	White arsenic			Calcium arsenate [1] (producers)	Lead arsenate [2] (producers)
	Producers	Government	Total		
1942	2,187	2,693	4,880	2,584	2,223
1943	1,138	1,018	2,156	4,757	4,020
1944	2,760	3,029	5,789	7,648	7,404
1945	2,299	1,987	4,286	[3] 6,389	[3] 6,869
1946	471	----------	471	(4)	(4)

[1] Basis, 100 percent $Ca_3(AsO_4)_2$. From U. S. Department of Commerce.
[2] Acid and basic. From U. S. Department of Commerce.
[3] As of September 30; year-end data not available.
[4] Data not available.

FOREIGN TRADE [4]

Imports.—White arsenic imports in 1946 increased 5 percent over 1945 but continued considerably below 1937, when imports were the highest ever recorded. Of the total 1946 imports, Mexico supplied 74 percent, Peru 17 percent, Sweden 5 percent, and Canada and U. S. S. R. each 2 percent. Importation of arsenic from Russia was the first ever recorded, and for the first time in several years arsenic was received from Sweden. Imports of metallic arsenic in 1946, largely from the United Kingdom, were the greatest since 1937.

Exports.—Exports of arsenicals were 63 percent larger than in 1945. Calcium arsenate was exported principally to France (45 percent) and Peru (38 percent) and lead arsenate to Brazil (25 percent), Argentina (22 percent), Cuba (20 percent), and Union of South Africa (11 percent). Statistics on white arsenic and paris green exports were not separately classified in 1946.

White arsenic (As_2O_3 content) imported for consumption in the United States, 1942–46, by countries

Country	1942 [1]		1943		1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Canada	1,449	$32,977	35	$2,349	5	$100	1	$73	275	$24,074
Mexico	14,901	859,836	15,974	870,380	7,654	424,911	9,665	533,305	10,309	571,483
Peru	--------	--------	103	3,945	2,306	120,344	3,483	154,595	2,345	100,693
Sweden	--------	--------	--------	--------	--------	--------	--------	--------	642	57,942
U. S. S. R.	--------	--------	--------	--------	--------	--------	--------	--------	251	18,833
	16,350	892,813	16,112	876,674	9,965	545,355	13,149	687,973	13,822	773,025

[1] Gross weight; not strictly comparable with later years.

[4] Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Arsenicals imported into and exported from the United States, 1942–46, by classes, in pounds

Class	1942	1943	1944	1945	1946
Imports for consumption:					
White arsenic (As_2O_3 content)	[1] 32,700,351	32,224,879	19,929,608	26,297,962	27,641,765
Metallic arsenic	6,854	6,840	21,395	51,501	92,064
Sulfide				2,226,560	88,184
Calcium arsenate	215	514			
Sheep dip	272,540	545	159,867	197,000	1,460
Sodium arsenate		133,247			
Lead arsenate					552
Exports:					
White arsenic [2]	610,206	3,950,657	4,802,932	1,715,855	(3)
Calcium arsenate	3,941,722	6,384,559	2,411,095	3,499,625	6,877,347
Lead arsenate	592,029	3,054,326	4,265,513	6,339,103	2,795,205
Paris green (cupric acetoarsenite)	171,644	1,062,640	1,138,435	456,811	(3)

[1] Gross weight; not strictly comparable with later years.
[2] 1942: As reported to Bureau of Mines by the producers; 1943–46: As reported by the U. S. Department of Commerce.
[3] Beginning January 1, 1946 not separately classified.

WORLD REVIEW

The world production record of white arsenic in recent years, insofar as data are available, is shown in the following table.

World production of white arsenic, 1938–46, by countries, in metric tons [1]

[Compiled by B. B. Mitchell]

Country [1]	1938	1939	1940	1941	1942	1943	1944	1945	1946
Australia (Western Australia)	4,063	1,439	3,385	3,432	2,771	2,320	2,341	2,021	1,651
Austria [3]	(2)	(2)	(2)	(2)	36	310	(2)	(2)	(2)
Belgium-Luxembourg (exports)	2,706	3,332	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Brazil	519	713	1,088	1,172	900	970	840	962	[4] 900
Canada	987	790	950	1,605	3,562	1,430	1,192	928	338
China	[4] 100	[4] 100	[4] 80			(2)	(2)	(2)	(2)
France	7,578	5,993	7,034	4,792	4,882	4,837	1,704	(2)	(2)
Germany	[5] 2,845	[3] 1,259	[3] 1,507	[3] 1,393	[3] 1,616	[5] 5,604	(2)	(2)	(2)
Greece	77	113	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Italy	810	1,151	1,283	541	(2)	(2)	(2)	(2)	(2)
Japan [6]	3,474	3,541	3,335	3,506	2,093	[7] 2,284	[7] 1,415	(2)	(2)
Korea (Chosen)	132	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Mexico	8,894	7,063	9,268	12,844	18,520	20,301	15,306	15,013	9,648
Peru					7	1,195	6,900	2,717	726
Portugal	1	426	410	535	(2)	(2)	(2)	(2)	(2)
Rumania	3						(2)	(2)	(2)
Southern Rhodesia	19		5		175	1,681	857	443	215
Spain	11	(2)	14	94	222	239	337	393	440
Sweden [3]	21,480	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Union of South Africa								100	12
United Kingdom	66	62	134	68	74	98	67	50	(2)
United States	15,136	20,267	22,664	29,466	26,019	28,306	32,744	22,089	9,263
Total [8]	69,000	46,500	53,400	60,700	63,000	71,600	66,200	51,600	32,800

[1] Arsenic is also believed to be produced in Czechoslovakia, Hungary, Iran, New Zealand, Spanish Morocco, Turkey, and U. S. S. R., but data are not available.
[2] Data not available; estimate included in total.
[3] Arsenic (As) content of ore mined.
[4] Estimate.
[5] Exports.
[6] Preliminary data for fiscal year ended March 31 of year following that stated.
[7] Incomplete data.
[8] Estimated by author of chapter; excludes estimates of countries listed in footnote 1.

Canada.—The output of white arsenic in Canada during 1946 totaled 745,000 pounds, valued at C$39,100, compared with 2,045,730 pounds, valued at C$130,909 in 1945. Of the 1946 production, 420,000 pounds came from Quebec and 325,000 pounds from Ontario.

China.—Arsenic is produced in China mainly as a byproduct of tin mining and subordinately from deposits of realgar and orpiment. In Hunan and Kwangsi the arsenopyrite ores recovered from tin-arsenic veins are distilled locally to arsenic oxide and sold chiefly for production of insecticides. Approximately two-thirds of the arsenic consumed in China comes from this source.[5]

Mexico.—Mexico ranks among the world's leading producers of arsenic. Arsenical flue dust is recovered in Cottrell units at lead smelters of the American Smelting & Refining Co. at San Luis Potosi and the American Metal Co., Ltd., at Torreon. Companies manufacturing arsenical insecticides from white arsenic all located in Mexico, D. F., include Fertilizantes de Mexico, S. A.; Cromo Industrial, S. A.; Productos Quimicos Mexicanos, S. A.; and General Electroquimica, S. A.[6]

Sweden.—Exports of arsenicals, which were prohibited in 1941 as a wartime measure, were resumed in 1945. White arsenic containing a minimum of 99 percent As_2O_3 is produced in Sweden by the Boliden Mining Co. from crude arsenic containing 70 percent As_2O_3. The crude arsenic is obtained as a byproduct in roasting of ore from the Boliden mine. In addition to copper, gold, and silver, the ore averages 7 percent arsenic.

[5] Juan, Vei Chow, Mineral Resources of China: Econ. Geol., vol. 41, No. 4, pt. 2, June-July 1946, p. 450.
[6] Lee, James A., Mexico's Chemical Industry: Chem. and Met., vol. 53, No. 6, June 1946, pp. 120–131.

Asbestos

By G. W. JOSEPHSON AND DOROTHY I. MARSH

GENERAL SUMMARY

IN 1946 the demand for asbestos far exceeded the supply. Construction and other consuming industries were booming, and they could have absorbed more asbestos products than manufacturers were able to furnish. Consequently, old plants were expanded and many new ones built. Part of this expansion program was undertaken with insufficient consideration of the availability of raw asbestos.

Domestic production of asbestos, principally from Vermont, totaled 14,426 short tons in 1946, 6 percent more than in 1945. Domestic mines furnished only 3 percent of the asbestos consumed in the United States in 1946. Imports reached a record tonnage.

Most of the chrysotile consumed in the United States is imported from Canada. Smaller quantities come from Africa and Russia. The imports from Africa were of the longer grades. Before the war Russia exported a substantial tonnage of chrysotile, but at present her sales to other countries are very small. All of the Russian asbestos received in 1946 was classified as crude.

All of the amosite used in this country for molded and other insulation products was imported from South Africa. Virtually all of the blue asbestos (crocidolite) used in asbestos-cement pipe came from South Africa; a small tonnage came from Australia. The unfavorable location of the Australian deposits limits their ability to compete.

Domestic production of tremolite asbestos for filtering was reported from California only. Limited quantities of amphibole asbestos were produced in several States.

Salient statistics of the asbestos industry in the United States, 1945–46

	1945		1946	
	Short tons	Value	Short tons	Value
Domestic asbestos—				
Produced:				
Chrysotile	13,340	[1]	13,989	[1]
Amphibole	250	[1]	437	[1]
Total produced	13,590	[1]	14,426	[1]
Sold or used by producers:				
Chrysotile	11,986	[2] $442,056	13,645	$499,260
Amphibole	240	3,989	430	5,504
Total sold or used by producers	12,226	[2] 446,045	14,075	504,764
Imports (unmanufactured)	374,199	16,284,915	456,688	18,731,378
Exports (unmanufactured)	8,550	837,175	11,011	1,395,367
Apparent consumption [3]	377,875	[2] 15,893,785	459,752	17,840,775
Exports of asbestos products	[1]	7,264,087	[1]	9,263,092

[1] Figure not available.
[2] Revised figure.
[3] Quantity sold or used by producers, plus imports, minus exports.

Among the minerals that will be stock-piled by the Army and Navy Munitions Board are some grades of amosite and long-fiber grades of chrysotile that ordinarily are obtained from Africa. Funds were appropriated by the Congress in 1946; but the purchase program remained relatively inactive, owing to the shortage of supply. Stocks of asbestos accumulated by the Government during the war were being sold to industry and at the end of the year were nearly depleted.

In accord with the general trend, prices of raw asbestos increased in 1946.

Salient statistics for asbestos in 1945 and 1946 are summarized in the preceding table.

The following table shows domestic output of asbestos during recent years according to varieties.

Asbestos sold or used by producers in the United States, 1942–46, by varieties

Year	Chrysotile		Amphibole		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1942	13,373	$480,245	2,108	$18,612	15,481	$498,857
1943	3,900	302,289	2,114	32,526	6,014	334,815
1944	6,275	373,112	392	7,222	6,667	380,334
1945	11,986	[1] 442,056	240	3,989	12,226	[1] 446,045
1946	13,645	499,260	430	5,504	14,075	504,764

[1] Revised figure.

REVIEW BY STATES

Alaska.—Small quantities of tremolite and chrysotile asbestos have been produced in the Kobuk River district in recent years by the Arctic Circle Exploration Co., Candle, Alaska, but no output was reported for 1946.

Arizona.—The Arizona Chrysotile Asbestos Co. of Globe was again the largest producer in the State. Arthur Enders of Globe purchased, milled, and resold asbestos but did not mine in 1946. The Globe Asbestos Co. operated the Fiber King mine in Gila County. Total sales of Arizona fiber were somewhat lower than in 1945. All the asbestos produced in Arizona was chrysotile. The mill of the Globe Asbestos Co. was operated part of the last 2 months of 1946.

California.—The Powhatan Mining Co. (Woodlawn, Baltimore, Md.) produced tremolite asbestos near Castella, Shasta County. Homer Fenn of Hazel Creek reported production of tremolite from the Loma Blanca mine in Shasta County. Production of amphibole asbestos was reported also by H. Zimdars and J. Delume of Foresthill, Placer County.

Georgia.—The only asbestos production in Georgia in 1946 came from an amphibole mine near Dillard, Rabun County, operated by Powhatan Mining Co. of Woodlawn, Baltimore, Md.

North Carolina.—Powhatan Mining Co. was also the only producer of asbestos in North Carolina in 1946. The mine is near Dillard, Ga., but is across the State line in Macon County, N. C.

Vermont.—The Vermont Asbestos Mines Division of the Ruberoid Co. (500 Fifth Ave., New York 18, N. Y.) operated its mill, near

Eden, three shifts a day. Construction of additional mill capacity is being considered, but no major equipment was installed in 1946. The company obtains some exceptionally long fiber from its nearby mine; but it has not been adapted to spinning uses, and the entire output is milled to nonspinning grades. Production was substantially greater than in 1945.

TRENDS IN CONSUMPTION

The accompanying table shows the domestic consumption of unmanufactured asbestos and the value of asbestos products exported during the past 10 years. Statistics of asbestos products manufactured in the United States have not been compiled by the Bureau of the Census since 1939.

Raw asbestos consumed in and asbestos products exported from the United States, 1937–46

Year	Raw asbestos—apparent consumption (short tons)	Asbestos products—exports (value)	Year	Raw asbestos—apparent consumption (short tons)	Asbestos products—exports (value)
1937	316,263	$3,047,078	1942	433,919	$5,116,919
1938	187,150	2,533,916	1943	445,902	4,877,864
1939	255,547	3,354,920	1944	389,241	5,614,243
1940	262,199	3,473,248	1945	377,875	7,264,087
1941	438,741	4,835,194	1946	459,752	9,263,092

Asbestos is widely used in industry in such products as pipe covering, packing, gaskets, and friction materials; and the building industry provides a large market for asbestos-cement products, floor tile, insulation, and other uses. The correlation between activity in construction, general industrial production, and asbestos consumption during the past 27 years is shown in figure 1.

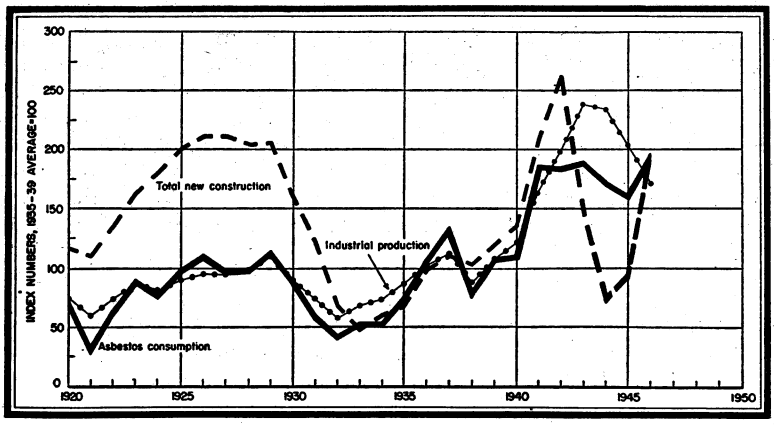

FIGURE 1.—Consumption of asbestos compared with total new construction and industrial production, 1920–46. Units are reduced to percentages of the 1935–39 average. Statistics on value of construction from Bureau of Foreign and Domestic Commerce and on industrial production from Federal Reserve Board.

MARKET CONDITIONS

Demand for asbestos increased in virtually all consuming countries in 1946, and a world-wide shortage developed. European and Asiatic factories that were cut off from the major sources of supply during the war were in the market for large tonnages of raw asbestos. In the past few years, eight asbestos-cement plants have been built in Latin America.[1] Similarly the American asbestos-products industry has grown. In 1946 the demand for products was so great that virtually all plants could have operated at capacity, but not enough raw material was available. The most acute shortage was of the grades of fiber suitable for the manufacture of asbestos-cement products, and there was also a severe deficiency in groups 6 and 7. Prolonged strikes in the factories of some of the principal manufacturers made available a substantial quantity of raw asbestos to the others, but this afforded only minor relief. At their present rate of expansion, there is little prospect that the mines will be able to satisfy the demand in the coming year. As Russian exports of raw asbestos are now very small, the burden of supplying the world market has fallen on Canada and Africa.

PRICES

The prices of asbestos, in common with most other commodities, increased during 1946. As quoted in the magazine Asbestos, the prices per short ton of Canadian fiber, f. o. b. mines, in January were as follows, in United States currency: Group 1 (Crude No. 1), $650–$750; group 2 (Crude No. 2, Crude Run-of-Mine and Sundry), $165–$385; group 3 (Spinning or Textile Fiber), $124–$260; group 4 (Shingle Fiber), $62.50–$90; group 5 (Paper Fiber), $44–$53; group 6 (Waste, Stucco, or Plaster), $33–$35; and group 7 (Refuse or Shorts), $14.50–$30.

Prices of Canadian asbestos increased after June, and in December these figures were quoted: Group 1 (Crude No. 1), $800; group 2 (Crude No. 2, Crude Run-of-Mine and Sundry), $275–$495; group 3 (Spinning or Textile Fiber), $155–$286; group 4 (Shingle Fiber), $75–$102.50; group 5 (Paper Fiber), $52.50–$59; group 6 (Waste, Stucco, or Plaster), $39; and group 7 (Refuse or Shorts), $17.50–$34.

The prices per short ton of Vermont asbestos quoted in January 1946 were: Shingle Stock Fibers, $62.50–$65.50; Paper Stock Fibers, $44–$54; Waste, $33; Floats, $19.50; and Shorts, $14.50–$28.50. By December they were: Shingle Stock Fibers, $75–$83; Paper Stock Fibers, $52.50–$59; Waste, $39; Floats, $24; and Shorts, $18.50–$35.

NEW DEVELOPMENTS

Many new or improved asbestos products, such as spray-coated insulation for corrugated sheets, asbestos ash trays, ironer pads, and wine and sugar filters, attracted attention in 1946, but of greater immediate significance was the growth of some established products. In past years there has always been a surplus of the very short fibers that are not suited for use in asbestos-cement or paper. However,

[1] Asbestos, Acute Shortage of Shingle Fiber Revealed by Survey: Vol. 28, No. 5, November 1946, pp. 2–4

this material is satisfactory for floor tile and consequently its status has changed unexpectedly. Floor-tile production capacity has increased so rapidly that not enough short asbestos is being recovered to satisfy the need. Equipment is being installed in the mills to increase recovery of these waste shorts, and it is expected that the trend in milling practice will be toward finer grinding.

With the shortage of asbestos has come a growth of interest in new deposits. There have been several reports of discoveries or development of known deposits. From South Africa came a statement that Stoltzburg Asbestos Holdings, Ltd., was preparing to open a mine on farm Stoltzburg No. 202 in the Carolina district.[2] A mill has been erected by Australian Blue Asbestos, Ltd., at Wittenoom, Western Australia, to produce blue fiber.[3] A large deposit of amosite is said to have been found in Wadi Hafafit in Baramia district of Upper Egypt. A deposit that may have practical interest to American consumers has been found in the Lewis Brook area on the west coast of Newfoundland. It has been examined by geologists and is believed to be of commercial size.

The growing desire of foreign countries to develop asbestos-products plants may have a considerable effect both on our export market and on the demand for raw asbestos. American companies have indicated a willingness to furnish technical and other assistance on such projects.

Interest in substitutes has also increased. The blending of fibrous glass and asbestos tends to relieve the shortage and also often yields a product having better properties than either material alone could achieve.[4] A fireproof wallboard consisting of cement and treated wood fibers is reported to have been developed for interior walls.

Some companies are interested in the possibility of producing asbestos synthetically. The Germans claim to have made a low-quality amphibole by crystallization from a vapor. Although the venture was not a commercial success, the fact that a fibrous product was made may have significance for the future.

FOREIGN TRADE [5]

More asbestos was imported into the United States in 1946 than in any previous year. Most of it came from Canada, but minor quantities of fiber came from Africa, Russia, and elsewhere. Receipts from U. S. S. R. totaled about the same as in 1945, but imports from South Africa declined sharply. The following table shows imports of unmanufactured asbestos into the United States during the past 2 years.

[2] South African Mining and Engineering Journal, New Asbestos Property: Vol. 56, No. 2765, February 1946, p. 594.
[3] Asbestos, Asbestos Mill at Wittenoom, Australia: Vol. 28, No. 3, September 1946, p. 10.
[4] Pryor, R. R., Fiberglas and Asbestos: Asbestos, vol. 28, No. 5, November 1946, pp. 8-12.
[5] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Asbestos (unmanufactured) imported for consumption in the United States, 1945–46, by countries and classes

Country	Crude (including blue fiber)		Mill fibers		Short fibers		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1945								
Australia	2	$162					2	$162
Canada	780	293,858	137,734	$9,105,325	217,254	$4,813,867	355,768	14,213,050
Cuba	11	1,975					11	1,975
Southern Rhodesia	2,545	531,501					2,545	531,501
Union of South Africa	13,247	1,363,434					13,247	1,363,434
U. S. S. R.	2,625	174,183					2,625	174,183
United Kingdom	1	610					1	610
	19,211	2,365,723	137,734	9,105,325	217,254	4,813,867	374,199	16,284,915
1946								
Australia	24	1,804					24	1,804
Brazil	(1)	78					(1)	78
Canada	521	228,073	153,002	10,362,252	288,550	6,604,040	442,073	17,194,365
China	313	62,206					313	62,206
Italy	6	4,320	2	2,655			8	6,975
Southern Rhodesia	5,239	723,381	224	25,231			5,463	748,612
Union of South Africa	6,050	574,106					6,050	574,106
U. S. S. R.	2,750	142,294					2,750	142,294
United Kingdom	(1)	63					(1)	63
Venezuela			7	875			7	875
	14,903	1,736,325	153,235	10,391,013	288,550	6,604,040	456,688	18,731,378

[1] Less than 1 ton.

The following table shows imports and exports of unmanufactured asbestos for 1942–46.

Asbestos (unmanufactured) imported for consumption in and exported from the United States, 1942–46

Year	Imports		Exports	
	Short tons	Value	Short tons	Value
1942	419,242	$21,217,650	774	$134,411
1943	440,255	23,053,524	367	36,856
1944	383,049	18,542,940	475	58,983
1945	374,199	16,284,915	8,550	837,175
1946	456,688	18,731,378	11,011	1,395,367

The following table shows exports of asbestos products in 1945 and 1946. The value of exports increased 28 percent.

Manufactured asbestos products exported from the United States, 1945–46, by kinds

Products	1945		1946	
	Quantity	Value	Quantity	Value
Brake lining:				
Molded and semimolded ..... short tons	1,093	$1,580,652	1,248	$1,837,752
Not molded ..... linear feet	353,028	236,099	740,670	368,680
Clutch facing ..... number	1,360,846	555,995	1,196,241	500,046
Paper, millboard, and roll board ..... short tons	754	136,019	653	141,837
Pipe covering and cement ..... do	1,825	213,468	1,103	145,010
Textiles, yarn, and packing ..... do	1,665	1,994,297	2,327	2,674,573
Asbestos roofing ..... squares	119,770	676,898	129,728	806,182
Other asbestos manufactures, except roofing ..... short tons	6,047	1,208,100	8,734	1,695,386
Magnesia and manufactures ..... do	9,131	662,559	17,423	1,093,626
		7,264,087		9,263,092

WORLD REVIEW [6]

Available statistics of asbestos production throughout the world from 1938 to 1946 are shown in the following table.

World production of asbestos, 1938–46, by countries, in metric tons [1]

Country [1]	1938	1939	1940	1941	1942	1943	1944	1945	1946
Argentina		110	150	84	51	349	(2)	(2)	(2)
Australia:									
New South Wales			9	38	142	422	353	500	(2)
South Australia	49	46	119	152	64	11	6	7	(2)
Tasmania	4			4	7	19	105	281	(2)
Western Australia	123	279	370	62	121	247	313	1,036	(2)
Bolivia	21	[3] 2	[3] 71	[3] 211	[3] 58	[3] 22	[3] 13	[3] 61	(2)
Brazil	120	45	500	[3] 13	(2)	(2)	(2)	(2)	(2)
Canada (sales) [4]	262,894	330,642	313,504	433,492	398,669	423,831	380,349	423,559	496,849
China	700	18,015	20,015	20,515	20,615	(2)	(2)	(2)	(2)
Cyprus (exports)	5,668	10,377	9,673	4,874	3,128	1,186	1,983	3,125	5,993
Egypt						7	240	[5] 50	55
Finland [6]	6,422	6,220	5,337	3,842	4,679	7,466	7,733	4,197	(2)
France	450	(2)	(2)	(2)	(2)	(2)	(2)	1,016	587
French Morocco					116	182	507	(2)	(2)
Greece	85	2	(2)	(2)	(2)	(2)	(2)	(2)	(2)
India	90	266	251	372	514	293	592	(2)	(2)
Indochina				22	146	312	2,450		(2)
Italy	6,860	6,765	8,271	10,766	11,695	[7] 7,419	(2)	4,811	(2)
Japan	[8] 1,000	[8] 1,000	[8] 1,000	(2)	[9] 1,526	6,418	[9] 9,395	[9] 2,659	1,706
Kenya Colony	5	(2)	(2)	213	307	321	341	389	(2)
Korea (Chosen)	286	(2)	(2)	(2)	(2)	(2)	4,815	(2)	(2)
Madagascar				3	11	(2)	3	1	(2)
New Zealand				54	43	190	17	2	(2)
Southern Rhodesia	53,352	52,900	50,809	40,037	50,623	52,749	52,882	51,118	50,686
Spain				2	84	50		(2)	(2)
Swaziland		7,233	18,873	19,166	23,219	17,179	29,628	21,243	29,155
Switzerland					6	11	7	35	(2)
Turkey	668	88	99	146	295	133	231	138	(2)
Uganda	53	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Union of South Africa	21,025	20,003	24,849	25,422	31,351	32,346	31,372	25,597	[8] 13,095
U. S. S. R.	86,000	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
United States (sold or used producers)	9,471	14,024	18,198	22,127	14,044	5,456	6,048	11,091	12,769
Venezuela	(2)	(2)	20	(2)	(2)	(2)	(2)	(2)	(2)

[1] In addition to countries listed asbestos is produced in Algeria, Bulgaria, and Czechoslovakia.
[2] Data not available.
[3] Exports.
[4] Exclusive of sand, gravel, and stone (waste rock only), production of which is reported as follows: 1938, 2,975 tons; 1939, 3,535 tons; 1940, 5,880 tons; 1941, 7,669 tons; 1942, 7,339 tons; 1943, 6,272 tons; 1944–46 data not available.
[5] January to September, inclusive.
[6] Includes asbestos flour.
[7] January to June, inclusive.
[8] Approximate.
[9] Incomplete figure.

[6] Statistics compiled by B. B. Mitchell.

CANADA

In 1946, output of asbestos in the Province of Quebec, Canada, attained a new record, 15 percent higher than the one established in 1941 and 17 percent more than the tonnage reported in 1945.

To meet the great demand for Canadian chrysotile, the capacities of mines and mills are being rapidly increased. When its present program of mill expansion and development of underground mining is completed, Canadian Johns Manville Co., Ltd., will have increased its capacity by 50 percent. The new mine and mill of Flintkote Mines, Ltd., 4 miles northeast of the city of Thetford Mines, went into production in June 1946.

The statistics in the accompanying table of Canadian sales of asbestos were supplied by the Department of Mines of the Province of Quebec.

Sales of asbestos in Canada, 1945–46, by grades

	1945			1946 [1]		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Grade:						
Crudes	981	$415,203	$423.24	741	$334,646	$451.61
Fibers	219,767	16,628,467	75.66	228,234	17,174,712	75.25
Shorts	246,148	5,761,487	23.41	318,710	7,591,676	23.82
	466,896	22,805,157	48.84	547,685	25,101,034	45.83
Rock mined	8,765,370			9,127,859		
Rock milled	6,459,813			7,027,483		

[1] Preliminary.

AFRICA

Southern Rhodesia.—In the mineral production of Southern Rhodesia, the value of asbestos ranks second only to gold. Some is sold to the United States, but most of the exports go to other consumers. In 1945 the United Kingdom took 17,499 short tons; Australia, 8,192; India 5,115; Belgium, 4,680; France, 3,078; the United States, 2,281; Argentina, 2,700; and Sweden, 2,100. Production statistics for recent years are shown in the accompanying table.

Asbestos produced in Southern Rhodesia, 1941–46

Year	Short tons	Value	Year	Short tons	Value
1941	44,134	£910,041	1944	58,293	£1,674,467
1942	55,803	1,488,052	1945	56,348	1,788,386
1943	58,146	1,673,025	1946	55,872	1,676,503

Swaziland.—As shown in the table of world production, output of chrysotile asbestos in Swaziland has increased rapidly since 1939. In 1946, production was nearly as great as in the record year 1944.

Union of South Africa.—Since 1943, asbestos output in the Union of South Africa has declined steadily, and data covering the first 9 months indicate that this trend continued in 1946. Available statistics on production and exports, by Provinces, are shown in the following table.

Asbestos produced in and exported from the Union of South Africa, 1942–46 [1]

Year	Production (short tons)				Exports [2]	
	Transvaal	Cape Province	Natal	Total	Short tons	Value
1942	27,278	7,281	(3)	34,559	30,169	£731,408
1943	27,768	7,888	(3)	35,656	35,940	880,019
1944	26,747	7,835	(3)	34,582	28,174	672,941
1945	20,016	8,200	(3)	28,216	22,005	591,124
1946 [4]	9,052	5,383	(3)	14,435	13,186	339,000

[1] Data from Union of South Africa, Department of Mines, Quarterly Report.
[2] Revised. (Data previously listed included manufactures.)
[3] Data not available.
[4] January to September, inclusive.

Output of all the four varieties of asbestos that are regularly marketed in South Africa were reported in 1946. However, the production of amosite was much lower than in recent years. The following table shows the tonnage of each variety produced, by Provinces, during the past 5 years.

Asbestos produced in the Union of South Africa, 1942–46, by varieties and sources in short tons [1]

Variety and source	1942	1943	1944	1945	1946 [2]
Amosite (Transvaal)	24,924	23,189	22,848	16,737	6,889
Chrysotile (Transvaal)	1,917	2,034	2,014	1,765	1,256
Blue (Transvaal)	360	2,456	1,831	1,471	877
Blue (Cape)	7,281	7,888	7,835	8,200	5,383
Anthophyllite (Transvaal)	77	89	54	43	30
	34,559	35,656	34,582	28,216	14,435

[1] Data from Union of South Africa, Department of Mines, Quarterly Report.
[2] January to September, inclusive.

OTHER COUNTRIES

In addition to those previously mentioned, the only other country known to have a substantial asbestos production is Russia. In 1938 its output was reported to have been 86,000 metric tons, but no production statistics have been released for subsequent years. As shown in the world table, relatively minor but locally significant tonnages of asbestos are produced in many countries.

Output of asbestos fiber in Italy is gradually recovering.

An asbestos mill owned by Campañía Minas de Cemento de Tinaquilla has gone into operation at Tinaquilla, State of Cojedes, Venezuela.

Asphalt and Related Bitumens

By A. H. REDFIELD

GENERAL SUMMARY

DOMESTIC demand for petroleum asphalt was 13 percent higher and export demand 83 percent higher in 1946 than in 1945. Export demand, however, was only 5 percent of the total demand, domestic and foreign, so that the total demand increased 15 percent in 1946 over 1945. To meet the greater demand, petroleum refineries in the United States enlarged their output 15 percent from 1945 to 1946. But less petroleum and lake asphalt was imported, and more petroleum asphalt was drawn from stocks in 1946 than in 1945. In numerical terms, an increase of 895,702 short tons in domestic demand and of 175,801 tons in export demand, as well as a rise in inventories of 9,300 tons during 1946, could be met by an increase of 1,039,000 tons in refinery production and a rise of 66,500 tons in stocks during 1945. On the other hand, imports of petroleum and lake asphalt decreased 24,697 tons from 1945 to 1946.

Bituminous rock was manifestly affected by the increased activity in highway construction and maintenance. Sales of bituminous sandstone and limestone were 21 percent larger in 1946 than in 1945, but prices were lower, and the sales value increased only 11½ percent from 1945 to 1946. Gilsonite sales increased 12 percent in tonnage and value from 1945 to 1946. Exports of natural asphalt (unmanufactured) were 44 percent lower in 1946 than in 1945.

NATIVE ASPHALT AND BITUMENS

Bituminous Rock.—As a result of increased activity in highway construction and maintenance in 1946 over 1945, sales of bituminous sandstone and limestone by producers in the United States increased from 642,600 short tons valued at $2,565,925 in 1945 to 777,467 tons valued at $2,861,591 in 1946. The increases occurred chiefly west of the Mississippi River. Sales by producers in Texas and Oklahoma increased from 413,021 tons in 1945 valued at $1,054,380 to 532,634 tons valued at $1,197,395 in 1946. Sales were larger in Utah and in Missouri in 1946 than in 1945, but smaller in California. East of the Mississippi River, sales of bituminous rock by producers in Kentucky and Alabama increased from 192,381 tons valued at $1,235,928 in 1945 to 194,742 tons valued at $1,287,099 in 1946.

Gilsonite.—Sales of gilsonite by producers in northeastern Utah increased from 61,273 short tons valued at $1,250,546 in 1945 to 68,407 tons valued at $1,400,229 in 1946. The average sales value per ton at the mine or railhead increased only slightly—from $20.41 in 1945 to $20.47 in 1946.

Wurtzilite.—Sales of wurtzilite amounted to 24 short tons valued at $1,066 in 1946. None was sold in 1945.

MANUFACTURED OR PETROLEUM ASPHALT

Production.—Production of asphalt by petroleum refineries in the United States increased 15 percent from 1945 to 1946. The increase was all east of the Rocky Mountain foothills; California produced 15.7 percent less petroleum asphalt in 1946 than in 1945, and the Rocky Mountain refining district 15.5 percent less. The greatest increases, both in tonnage and in percentage, were in the East coast district and in the Indiana, Illinois, Kentucky, etc., district. The next greatest increases, both quantitative and proportional, were in the Gulf coast districts of Texas and Louisiana.

Stocks.—Stocks of petroleum asphalt held at refineries were little more than 1 percent higher on December 31, 1946, than on December 31, 1945. The national increase was due chiefly to larger stocks in the Rocky Mountain district, in California, and in the Indiana, Illinois, Kentucky, etc., district. On the other hand, these increases in inventories were largely offset by decreases in stocks held in the East coast, Appalachian, and Oklahoma-Kansas-Missouri districts and in Arkansas and inland Louisiana.

Production, receipts, stocks, consumption, transfers, losses, exports, and domestic sales of asphalt (exclusive of road oil) at petroleum refineries in the United States in 1946, by districts, in short tons

District	Production	Receipts [1]	Stocks		Consumption by producers, transfers, losses, and exports	Sales to domestic consumers
			Beginning of year	End of year		
East Coast	2,102,400	182,100	125,300	107,800	191,100	2,110,900
Appalachian	372,000	27,900	35,300	23,300	16,300	395,600
Indiana, Illinois, Kentucky, etc	1,884,600	107,300	140,500	161,300	474,700	1,496,400
Oklahoma, Kansas, and Missouri	700,200	114,100	79,100	58,400	21,300	813,700
Texas:						
Gulf Coast	395,000	----------	24,700	26,500	87,000	306,200
Inland	368,700	----------	37,100	34,200	53,000	318,600
Total Texas	763,700	----------	61,800	60,700	140,000	624,800
Louisiana-Arkansas:						
Louisiana Gulf Coast	499,600	----------	53,100	54,000	68,500	430,200
Arkansas and inland Louisiana	455,600	6,400	43,400	31,100	53,700	420,600
Total Louisiana-Arkansas	955,200	6,400	96,500	85,100	122,200	850,800
Rocky Mountain	244,900	55,300	46,700	84,300	18,700	243,900
California	1,142,600	----------	107,500	121,100	50,800	1,078,200
Total United States:						
1946	8,165,600	493,100	692,700	702,000	1,035,100	7,614,300
1945	7,126,600	651,500	626,200	692,700	860,600	6,851,000

[1] Receipts from interindustry refinery transfers, addition of other petroleum products blended to make cut-back asphalts, imports, and transfers from stocks formerly not classed as asphalt.

Sales.—Sales of petroleum asphalt to domestic consumers increased 11 percent in quantity and 19 percent in value from 1945 to 1946. The average value at the refinery increased from $11.51 per short ton in 1945 to $12.34 in 1946.

Of the total sold, 20 percent was manufactured from foreign petroleum (imported chiefly from Venezuela, Colombia, and Mexico) in 1946, compared with 16 percent in 1945. Although runs of foreign crude to stills increased 15 percent from 1945 to 1946, sales of petro-

leum asphalt from this source increased 43 percent. Of the foreign crude processed, 8 percent was converted to asphalt in 1945 and 10 percent in 1946. East coast refineries sold all of the asphalt made in the United States from foreign crude both in 1945 and in 1946.

Sales of asphalt (exclusive of road oil) at petroleum refineries to domestic consumers in the United States, 1945–46, by districts

District	1945		1946	
	Short tons	Value	Short tons	Value
East Coast	1,643,569	$22,621,332	2,110,922	$29,932,829
Appalachian	328,547	4,663,038	395,626	5,821,188
Indiana, Illinois, Kentucky, etc	1,287,862	15,490,678	1,496,378	18,877,986
Oklahoma, Kansas, and Missouri	731,012	6,645,035	813,744	8,507,583
Texas:				
Gulf Coast	218,593	2,259,179	306,187	3,390,888
Inland	239,915	2,399,721	318,582	3,845,883
Total Texas	458,508	4,658,900	624,769	7,236,771
Louisiana-Arkansas:				
Louisiana Gulf Coast	356,889	3,826,407	430,177	5,256,239
Arkansas and Inland Louisiana	409,842	3,122,176	420,627	3,844,018
Total Louisiana-Arkansas	766,731	6,948,583	850,804	9,100,257
Rocky Mountain	270,029	2,505,799	243,924	2,590,964
California	1,364,726	15,342,189	1,078,200	11,923,564
Total United States	6,850,984	78,875,554	7,614,367	93,991,142

Highway and street construction and airport-runway surfacing (in the form of paving asphalt, paving flux, cut-back asphalts, and asphalt emulsions) used 64 percent of the total asphalt sold to domestic consumers by petroleum refineries in 1945 and 60 percent in 1946. Street and road contracts exceeding $25,000 in 1945 and $40,000 in 1946, according to Engineering News-Record, showed an increase of 239 percent in value—from 227.3 million dollars in 1945 to 769.4 million dollars in 1946—and of 183 percent in indicated volume, if the values are adjusted by the Engineering News-Record index of construction costs. The increases were general, but were greatest in the 14 States west of the Mississippi River and east of the Rocky Mountains and in the 10 Southeastern States east of the Mississippi River and south of the Ohio and Potomac Rivers and including Louisiana.[1] Smaller increases occurred in the 5 Middle Atlantic States north of the Potomac River and in the 7 Pacific and Rocky Mountain States.[1] Total expenditures for maintenance and construction of highways by States, counties, and municipalities, as calculated by the American Association of State Highway Officials, increased from 1,341 million dollars in 1945 to 1,589 million dollars in 1946.

Although available statistics indicate greater activity in highway construction and maintenance in 1946 than in 1945, sales of paving asphalt used for high-type surfacing increased only 5 percent—from 1,904,002 short tons in 1945 to 1,994,621 tons in 1946. Sales of cut-back asphalts suitable for surfacing lighter-type highways were 2½ percent higher in 1946 than in 1945. The popularity of medium-curing cut-backs declined again; 11 percent less of this type of cut-

[1] States grouped according to Engineering News-Record.

Asphalt and asphaltic material (exclusive of road oil) sold at petroleum refineries to domestic consumers in the United States in 1946, by varieties

[Value f. o. b. refinery]

Variety	From domestic petroleum		From foreign petroleum		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Solid and semisolid products of less than 200 penetration:						
Asphalt for—						
Paving	1,461,154	$17,248,639	533,467	$7,308,431	1,994,621	$24,557,070
Roofing	1,244,424	15,505,447	457,561	6,302,302	1,701,985	21,807,749
Waterproofing	114,768	1,934,316	13,683	197,336	128,451	2,131,652
Blending with rubber	13,050	204,858	15,665	217,841	28,715	422,699
Briquetting	163,884	1,838,321	3,884	48,305	167,768	1,886,626
Mastic and mastic cake	9,510	148,400	27,125	371,978	36,635	520,378
Pipe coatings	28,545	394,541	3,229	38,539	31,774	433,080
Molding compounds	45,187	659,345	6,129	105,749	51,316	765,094
Miscellaneous uses	142,740	1,935,724	34,288	489,331	177,028	2,425,055
	3,223,262	39,869,591	1,095,031	15,079,812	4,318,293	54,949,403
Semisolid and liquid products of more than 200 penetration:						
Flux for—						
Paving	256,832	2,480,538	31,397	451,672	288,229	2,932,210
Roofing	812,997	7,621,529	53,845	708,715	866,842	8,330,244
Waterproofing	5,211	54,966	3,792	58,965	9,003	113,931
Mastic	2,333	33,766			2,333	33,766
Cut-back asphalts:						
Rapid-curing	627,339	8,229,971	244,265	3,559,736	871,604	11,789,707
Medium-curing	932,340	11,509,862	104,400	1,538,385	1,036,740	13,048,247
Emulsified asphalts and fluxes	56,323	634,743	594	8,263	56,917	643,006
Paints, enamels, japans, and lacquers	51,524	929,734	16,871	236,595	68,395	1,166,329
Other liquid products	96,011	984,299			96,011	984,299
	2,840,910	32,479,408	455,164	6,562,331	3,296,074	39,041,739
Total: 1946	6,064,172	72,348,999	1,550,195	21,642,143	7,614,367	93,991,142
1945	5,770,223	64,215,506	1,080,761	14,660,045	6,850,984	78,875,551

back was sold in 1946 than in 1945, but sales of rapid-curing cut-backs were 26 percent larger.

The quantity of emulsified asphalt sold in 1946 was less than in 1945, but the value was higher. Petroleum refineries sold 69,943 short tons (16,479,935 gallons) valued at $711,770 in 1945 and 56,917 tons (13,410,755 gallons) valued at $643,006 in 1946. In addition, 68,704,092 gallons or 291,589 short tons (revised figure) valued at $6,493,043 in 1945 and 67,367,106 gallons or 285,914 short tons valued at $7,235,122 in 1946 were sold by major industrial companies that purchased asphalt from petroleum refineries and manufactured it into emulsions. Accordingly, total known sales of emulsified asphalts and fluxes decreased 5 percent in quantity—from 85,184,027 gallons (revised figure) in 1945 to 80,777,861 gallons in 1946—but increased 9 percent in value—from $7,204,813 in 1945 to $7,878,128 in 1946.

Roofing manufacture made the second-largest demand for asphalt, absorbing 30 percent of the total sales to domestic consumers in 1945 and 34 percent in 1946. Although shipments of prepared roofing reported to the Bureau of the Census increased 24 percent—from 49,156,000 squares in 1945 to 60,865,000 squares—domestic sales of roofing asphalt and flux combined increased 25 percent—from

2,049,685 short tons in 1945 to 2,568,827 tons in 1946. These figures do not include roofing asphalt and flux consumed by the companies in factories of prepared roofing owned by themselves or by affiliated companies.

APPARENT CONSUMPTION

The apparent average monthly domestic consumption of petroleum asphalt (including small quantities of imported lake asphalt and grahamite) increased 13 percent—from 583,258 short tons in 1945 to 657,902 tons in 1946.

The period of high demand that had characterized 1940–45 continued into 1946. In terms of the long-term trend, apparent consumption was 38 percent above expected consumption for 1945 and 52 percent above that for 1946; that is, if the national demand had continued the average growth it manifested from 1908 to 1944, it would have averaged 423,173 short tons a month in 1945 and 657,902 tons in 1946. If these averages are used as a standard of comparison, apparent consumption of 583,258 tons a month in 1945 was 138 percent of the expected consumption (423,167 tons, revised figure) in 1945, and apparent consumption of 657,902 tons a month in 1946 was 152 percent of the expected consumption (434,315 tons).

Relation of indicated asphalt demand to basic trend, multiplied by seasonal factors, 1945–46, by months

Months	1945			1946		
	Apparent consumption (short tons)	Expected consumption [1] [2] (short tons)	Ratio of apparent to expected consumption [2] (percent)	Apparent consumption (short tons)	Expected consumption [1] (short tons)	Ratio of apparent to expected consumption (percent)
January	356,600	233,500	152.7	336,265	239,655	140.3
February	335,400	221,200	151.6	335,331	227,060	147.7
March	399,400	288,300	138.5	452,551	295,855	153.0
April	483,600	362,700	133.3	548,719	372,208	147.4
May	622,500	461,000	135.0	636,938	473,360	134.6
June	768,100	540,300	142.2	825,961	554,533	148.9
July	891,400	595,600	149.7	920,387	611,298	150.6
August	903,000	615,600	146.7	987,615	631,799	156.3
September	732,200	582,700	125.7	899,919	598,008	150.5
October	655,600	545,500	120.2	853,615	559,832	152.5
November	516,400	366,800	140.8	590,101	376,421	156.8
December	334,900	264,800	126.5	507,421	271,751	186.7
Total	6,999,100	5,078,000	137.8	7,894,823	5,211,780	151.5

[1] Total based upon 1908–1945 trend. Monthly figures obtained by applying seasonal factor based upon actual monthly distribution in 1925–46.
[2] Revised.

The downward trend in demand (relative to the long-term trend modified by seasonal indexes, on a monthly basis) that had been manifested in the second and fourth quarters of 1945 gave way to a definite rise in 1946. In the first quarters of both 1945 and 1946 demand averaged 47 percent above the expected figures. In the second quarter of 1946, however, demand was 44 percent above the expected figure, compared with 37 percent above expected in the corresponding months of 1945. From July to September 1946, demand was 53 percent higher than the calculated level, compared

with 41 percent above the calculated in the third quarter of 1945. In the last 3 months of 1946 demand averaged 62 percent over the trend figure, compared with 28 percent above the trend in the final quarter of 1945.

DISTRIBUTION BY RAIL

The tonnage of asphalt (natural, byproduct, or petroleum) terminated by class I railroads in the United States increased from 5,379,418 short tons in 1945 to 6,344,544 tons in 1946, according to freight-commodity statistics compiled by the Interstate Commerce Commission. Of the total deliveries, 54 percent in 1945 and 56 percent in 1946 were set down in the populous area north of the Ohio and Potomac Rivers and east of the Mississippi River, although this area comprises only 14 percent of the area of continental United States. In this area, terminations of asphalt rail shipments were 22 percent larger in 1946 than in 1945. In the States lying south of the Potomac and Ohio Rivers and east of the Mississippi River, 3 percent less asphalt was delivered by rail in 1946 than in 1945. Between the Mississippi River and the Rocky Mountains, railroad terminations of asphalt were generally larger in 1946 than in 1945. In the Mountain States the pattern of increases and decreases was spotty. On the

Asphalt (natural, byproduct, and petroleum) terminated by class I railroads in the United States, 1945–46, by States, in short tons

[Interstate Commerce Commission, Freight Commodity Statistics]

Region and State	1945	1946	Region and State	1945	1946
New England	113,078	199,491	East South Central:		
Middle Atlantic:			Kentucky	84,991	101,381
New York	178,777	302,623	Tennessee	76,613	112,091
New Jersey	82,980	79,720	Alabama	92,847	67,929
Pennsylvania	421,796	666,800	Mississippi	47,594	36,541
	683,553	1,049,143		302,045	317,942
East North Central:			West South Central:		
Ohio	1,173,229	1,116,896	Arkansas	37,596	53,845
Indiana	210,466	213,513	Louisiana	175,479	261,532
Illinois	379,018	550,150	Oklahoma	31,356	80,116
Michigan	154,270	181,492	Texas	183,983	227,842
Wisconsin	181,356	227,083		428,414	623,335
	2,098,339	2,289,134	Mountain:		
West North Central:			Montana	14,172	18,169
Minnesota	93,503	151,529	Idaho	15,566	30,923
Iowa	54,944	63,223	Wyoming	36,677	15,924
Missouri	99,385	149,177	Colorado	58,245	50,631
North Dakota	26,083	23,089	New Mexico	42,937	56,997
South Dakota	27,850	32,286	Arizona	26,716	29,898
Nebraska	43,764	72,538	Utah	22,987	20,247
Kansas	50,608	89,110	Nevada	13,717	22,564
	396,137	580,952		231,017	245,353
South Atlantic:			Pacific:		
Delaware	23,893	8,373	Washington	73,442	75,119
Maryland	72,934	19,923	Oregon	56,882	74,468
District of Columbia	989	1,603	California	382,535	317,888
Virginia	187,691	157,543		512,859	467,475
West Virginia	77,996	73,156			
North Carolina	63,188	118,833	Total United States	5,379,418	6,344,544
South Carolina	50,411	45,435	Canada	5,216	3,464
Georgia	55,772	66,820		5,384,634	6,348,008
Florida	81,102	80,033			
	613,976	571,719			

Pacific coast a decline in rail deliveries in California offset increases in Washington and Oregon. It may be noted, however, that railroad terminations of asphalt were equivalent to only 77 percent of the total indicated demand for asphalt in the United States in 1945 and 80 percent in 1946, and that considerable quantities of asphalt were delivered to consumers by water and by minor railroads and motor trucks. Accordingly, these figures do not present a complete picture of the consumption of asphalt by States.

FOREIGN TRADE[2]

Imports.—Imports of natural asphalt and bitumen into the United States in 1946 totaled 4,449 short tons valued at $92,419, compared with 5,148 tons valued at $122,207 in 1945. Imports of lake asphalt from Trinidad decreased from 4,926 short tons valued at $116,219 in 1945 to 3,943 tons valued at $82,625, but imports of grahamite from Cuba increased from 222 short tons valued at $5,927 in 1945 to 315 tons valued at $8,106 in 1946.

Imports of solid petroleum asphalt decreased from 142,802 short tons valued at $798,667 in 1945 to 97,204 tons valued at $536,697 in 1946. Virtually all of the 1945 and 1946 imports came from the Netherlands West Indies.

In addition, 22,161 barrels (4,029 short tons) of liquid petroleum asphalt valued at $43,028 were imported in 1945 and 140,959 barrels (25,629 tons) valued at $234,491 in 1946. The Netherlands West Indies supplied virtually all the liquid petroleum asphalt imported into the United States in 1945. Of the 1946 imports, 60,377 barrels (10,978 tons) valued at $101,433 came from Mexico and 80,556 barrels (14,646 tons) valued at $132,900 from the Netherlands West Indies.

Exports.—The tonnage of natural asphalt, unmanufactured, exported from the United States decreased from 47,094 short tons valued at $1,207,147 in 1945 to 26,588 tons valued at $974,404 in 1946. The most marked decreases were in exports to Australia and New Zealand, to India, and to parts of Africa where war construction had gone on. Europe was the principal foreign market for natural asphalt in 1946, absorbing 81 percent of the total exports. Shipments to northern, western, and Mediterranean Europe increased in spite of a decline in exports to Scandinavia. Shipments to Canada and to east coast countries of South America were greater in 1946 than in 1945.

Exports of petroleum asphalt from the United States in 1946 were 83 percent larger than in 1945 and were the largest since 1930. The most marked increase was in shipments to Europe, which in 1946 were nearly four times the 1945 shipments. With the exception of Sweden, all European countries listed received more asphalt from the United States in 1946 than in 1945. Increased shipments to China and southern Asia more than offset the sharp decline in exports of asphalt to India. In Africa, reduced shipments to the Union of South Africa, Mozambique, and Belgian Congo were more than counterbalanced by increased shipments to other parts of the continent. In Oceania, a sharp drop in exports to Australia was not compensated for by greater shipments to New Zealand. In general, these shifts indicate a change in emphasis from wartime activities to postwar reconstruction.

[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Petroleum asphalt exported from the United States, 1944–46, by countries

Country	1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value
North America:						
Canada	4,225	$238,827	4,223	$215,131	6,260	$322,259
Cuba	228	7,526	299	7,600	122	4,824
Guatemala	213	3,499	93	1,368	650	14,139
Mexico	2,989	47,068	1,274	21,588	4,439	64,726
Newfoundland and Labrador	2,008	29,081	2,242	45,566	2,040	48,052
Nicaragua	616	13,090	624	14,396	158	4,595
Panama:						
Canal Zone	1,695	46,968	115	3,175	151	3,086
Republic of	316	5,225	429	9,836	18	536
Other North America	1,467	26,677	2,999	68,503	1,234	29,054
	13,757	417,961	12,298	387,163	15,072	491,271
South America:						
Argentina	13	807	36	1,284	328	22,695
Bolivia	1,304	22,929	1,524	42,957		
Brazil	10,514	208,907	7,050	145,539	4,368	112,091
Chile	2,146	45,555	5,780	137,875	5,267	144,421
Uruguay	1,402	24,676	2,643	57,556	3,610	109,220
Venezuela	139	3,785	246	6,518	146	4,472
Other South America	998	26,600	272	8,530	125	4,198
	16,516	333,259	17,551	400,259	13,844	397,097
Europe:						
Belgium and Luxembourg					12,511	349,388
Denmark					5,235	122,016
France			8,813	215,378	125,839	3,268,304
Finland					4,276	108,335
Italy					43,353	978,101
Netherlands			357	8,838	5,493	136,868
Noway			4,592	118,806	5,645	147,935
Portugal	1,524	28,228	4,313	103,797	4,362	124,532
Spain			20,241	559,830	24,660	602,738
Sweden	527	15,531	26,870	753,259	13,567	353,574
Switzerland			2,971	81,413	9,583	235,278
Other Europe			222	7,487	1,615	43,546
	2,051	43,759	68,379	1,848,808	256,139	6,470,615
Asia:						
Ceylon			(1)	13	1,110	22,772
China			1,894	45,093	24,923	458,841
French Indochina					8,764	131,957
Hong Kong					2,709	49,011
India	17,348	405,267	48,755	1,142,680	671	19,512
Netherlands Indies					2,381	58,562
Philippines, Republic of			393	10,403	18,621	446,779
Other Asia	55	2,193	463	10,212	1,658	32,801
	17,403	407,460	51,505	1,208,401	60,837	1,220,235
Africa:						
Algeria					3,128	81,834
Belgian Congo	57	1,390	236	7,352	224	6,464
British East Africa	25	1,819	48	1,908	6	362
French West Africa			2,211	69,875	2,268	68,420
Mozambique	2	184	2,594	48,121	1,278	20,938
Nigeria			1,216	33,697		
Tunisia					4,470	107,886
Union of South Africa	3,286	60,942	13,100	228,266	10,693	212,363
Other Africa	1,605	53,288	827	20,170	2,046	63,504
	4,975	117,623	20,232	409,389	24,113	561,771
Oceania:						
Australia	57,724	1,128,337	41,179	876,866	7,869	167,785
New Zealand	6,786	157,214	1,695	38,246	10,885	200,175
Other Oceania			119	2,637		
	64,510	1,285,551	42,993	917,749	18,754	367,960
	119,212	2,605,613	212,958	5,171,769	388,759	9,508,949

[1] Less than 1 ton.

ROAD OIL

Reported sales of road oil by petroleum refineries in the United States increased 96 percent in quantity—from 2,567,000 barrels in 1945 to 5,034,000 barrels in 1946—and 150 percent in value—from $3,561,000 in 1945 to $8,894,000 in 1946. This marked increase in road-oil sales was due not so much to higher demand resulting from greater activity in highway construction and maintenance during 1946 as to the release of official controls on the use of petroleum residues and the greater availability of this low-cost material for surfacing highways for light traffic.

In 1946 four refining districts—Indiana, Illinois, Kentucky, etc.; Oklahoma-Kansas-Missouri; Rocky Mountain; and California—together made 92 percent of all road-oil sales in the United States The same districts in 1945 accounted for 72 percent of the national total.

Production, receipts, stocks, consumption, transfers, losses, exports, and domestic sales of road oil in the United States in 1946, by districts, in thousands of barrels

District	Production	Receipts [1]	Stocks		Consumption by producers, transfers, losses, and exports	Sales to domestic consumers
			Beginning of year	End of year		
East Coast	172	72	17	27	114	120
Indiana, Illinois, Kentucky, etc	1,701	147	17	47	472	1,346
Oklahoma, Kansas, and Missouri	758	47	6	49	237	525
Texas	102	155	5	5	24	233
Louisiana-Arkansas	22	22	6	6	17	27
Rocky Mountain	1,160	141	102	186	625	592
California	2,260	----------	217	286	----------	2,191
Total: 1946	6,175	584	370	606	1,489	5,034
1945	2,686	1,074	189	370	1,012	2,567

[1] Receipts from interindustry refinery transfers, imports, and transfers from stocks formerly not classed as road oil.

Road oil sold by petroleum refineries to domestic consumers in the United States, 1945–46, by districts

District	1945		1946	
	Thousands of barrels	Thousands of dollars	Thousands of barrels	Thousands of dollars
East Coast	16	36	120	293
Indiana, Illinois, Kentucky, etc	360	595	1,346	2,257
Oklahoma, Kansas, and Missouri	358	450	525	1,325
Texas	682	878	233	337
Louisiana-Arkansas	12	20	27	41
Rocky Mountain	616	876	592	960
California	523	706	2,191	3,681
Total United States	2,567	3,561	5,034	8,894

Barite

By CHARLES L. HARNESS AND F. M. BARSIGIAN [1]

	PAGE		PAGE
General summary	161	Barite—ground (and crushed)—Continued	
Salient statistics	162	Prices	169
Barite—primary	162	Foreign trade	170
Production and consumption	162	Witherite	170
Prices	165	Barium chemicals	170
Foreign trade	166	Production	170
World review	166	Prices	172
Barite—ground (and crushed)	168	Foreign trade	173
Sales	168		

GENERAL SUMMARY

BARITE production attained a new record of 725,223 short tons in 1946. Recent growth of the industry is shown by the fact that both 1944 and 1945 were themselves record years. The United States has been the world's leading producer of barite since 1940, having surpassed Germany in that year. Although increases were noted in shipments to nearly all of the customary consuming industries, oil-well drilling stands far to the fore as the major patron of the domestic barite industry. This use has been increasing ever since the early twenties, when barite was first added to rotary drilling mud in high-pressure areas to prevent blow-outs. In 1938 this use overtook shipments to lithopone plants to become the major use.—

Arkansas, with its two large flotation mills, produced more than any other State, shipping 288,286 short tons. Almost all went to well drillers, with a minor amount to glassmakers. Missouri, with its 23 washers, supplied the second greatest quantity, followed by Georgia.

The term "Primary barite" as used in this chapter applies to barite as first offered to the trade, whether lump, crushed, or ground. Such figures thus include ground barite from Malvern, Ark.; El Portal, Calif.; and Mesa, Ariz.; and lump barite from open pits and underground workings. Where ground barite has been reported to the Bureau of Mines as original production, an estimate of the value of the lump equivalent of the ground has been assigned to such tonnage.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Salient statistics of the barite, witherite, and barium-chemical industries in the United States, 1942–46

	1942	1943	1944	1945	1946
Barite:					
Primary:					
Produced—short tons	449,873	429,298	515,136	692,330	725,223
Sold or used by producers:					
Short tons	429,484	420,343	518,617	696,062	724,362
Value: [1]					
Total	$2,673,002	$2,796,776	$3,558,489	$5,348,652	$5,242,755
Average	$6.22	$6.65	$6.86	$7.68	$7.24
Imports for consumption:					
Short tons	4,680	----------	67,888	56,894	44,662
Value: [2]					
Total	$34,756	----------	$459,664	$382,611	$274,267
Average	$7.43	----------	$6.77	$6.72	$6.14
Apparent new supply [3]—short tons	434,164	420,343	586,505	752,956	769,024
Domestic—percent	98.9	100	88.4	92.4	94.2
Reported consumption—short tons	449,424	453,744	595,563	720,903	722,073
Ground (and crushed):					
Sold by producers: [4]					
Short tons	178,765	208,252	344,757	468,939	455,240
Value	$3,611,745	$3,743,919	$5,455,835	$7,519,759	$7,208,193
Imports for consumption:					
Short tons	----------	----------	11,964	1	----------
Value	----------	----------	$243,917	$15	----------
Witherite (crude):					
Imports for consumption:					
Short tons	3,066	448	----------	896	1,107
Value	$60,824	$9,452	----------	$26,736	$31,599
Barium chemicals:					
Sold by producers:					
Short tons	73,232	78,323	73,591	[5] 68,084	80,871
Value	$7,630,322	$8,345,422	$7,740,686	[5] $6,493,448	$7,003,756
Imports for consumption:					
Short tons	385	212	95	35	([6])
Value	$105,275	$33,120	$7,382	$3,098	$58
Lithopone:					
Sold or used by producers: [7]					
Short tons	137,320	135,723	142,905	136,161	147,001
Value	$10,828,924	$10,745,305	$11,208,891	$10,645,316	$11,840,596
Exports of lithopone:					
Short tons	17,036	17,320	11,551	11,576	9,651
Value	$1,733,698	$1,637,217	$1,107,430	$1,049,961	$888,555

[1] F. o. b. mine shipping point.
[2] Declared value f. o. b. foreign market.
[3] Barite sold or used by producers plus imports.
[4] Although all barite is crushed before use in chemicals, barite used in chemicals is not included in the 1945 and 1946 totals. In 1944 and prior years small quantities of crushed barite used by chemical producers are included.
[5] Revised figure; see table "Barium chemicals produced and used or sold by producers in the United States, 1942–46."
[6] Less than 1 ton.
[7] Exclusive of cadmium lithopone.

BARITE—PRIMARY

PRODUCTION AND CONSUMPTION

Spasmodic shipments of barite have been made from Arizona in the past, the last year of any substantial activity being 1938. In 1946 a determined bid for business in the southwestern and California oil fields was made by a new firm, the Arizona Barite Co.[2] The mine is at Coon Bluff, 22 miles northeast of Mesa, and the mill a short distance south of Mesa on the Southern Pacific Railway. The ore is mined underground, crushed, and wet-ground to 200-mesh with no attempt at concentration other than some hand sorting in the mine. The final product analyzes 94 percent barium sulfate with a specific gravity of 4.0 or better. Production is stated to be 100

[2] Mining World, Arizona Barite: Vol. 9, No. 1 January 1947, pp. 20–22.

Domestic barite sold or used by producers in the United States, 1944–46, by States

State	1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value
Arkansas	159,686	[1] $1,045,546	260,660	[1] $1,934,098	288,286	[1] $1,844,982
Georgia	108,851	929,090	110,393	1,056,035	69,274	686,583
Missouri	150,748	1,121,678	225,467	1,841,959	270,850	2,168,067
Nevada	22,390	84,859	28,919	106,052	[2]	[2]
Tennessee	43,033	279,567	32,812	256,756	33,595	272,169
Other States [3]	33,909	97,749	37,811	153,752	62,357	270,954
	518,617	3,558,489	696,062	5,348,652	724,362	5,242,755

[1] Partly estimated.
[2] Included under "Other States."
[3] 1944: California, North Carolina, and South Carolina; 1945: California and North Carolina; 1946: Arizona, California, and Nevada.

tons a day. The ore occurs in a series of fissure veins in a volcanic conglomerate. In addition to the main vein, which is being worked, seven additional veins have been partly explored. The main vein is about 15 feet wide and 3,000 feet long and has been opened to a depth of 140 feet by a steeply inclined development shaft. The company expects to mine by shrinkage stoping when full-scale operations are reached.

Waste heaps of barite washer tailings have been accumulating in Georgia, Tennessee, and Missouri for many years. In 1945 the Paga Mining Co., a barite producer in the Cartersville, Ga., area, erected a flotation mill and recovered barite fines from their washer tailings. The process has been described in detail by Avery.[3]

At Magnet Cove, Ark., where the Magnet Cove Barium Corp. and the National Lead Co. have been mining barite since 1941 and 1942, respectively, the increasing depth of the barite vein has forced both operators to abandon or modify their simple open-cut operations. The Magnet Cove Barium Corp. is resorting to underground mining, and the National Lead Co. proposes to strip off the overburden.

Requests for tariff reductions on barite asked by the Netherlands and Cuba were opposed by the domestic producers at public hearings held before the Committee for Reciprocity Information, Tariff Commission, on January 20, 1947. During the course of the testimony some rather interesting statements were made regarding costs, investments, exploratory work, and other phases of the barite industry. Walter Hester, of the National Lead Co., discussing reserves, stated that the National Lead Co. owns in fee simple 16,500 acres of land in Washington County, Mo., and leases it to barite washers on a royalty basis of 50 cents a ton of recovered barite. This acreage contains 2,000,000 tons of barite, and other barite-bearing land in the county brings the total to 20,000,000 tons, according to Hester's estimate. The National Lead Co. and Magnet Cove Barium Corp. have together proved 9,000,000 tons of reserves in the Hot Spring, Ark., area. Only 50,000 tons are left in the El Portal, Calif., deposit, but National Lead has blocked out three new deposits at Battle Mountain, Nev., with estimated reserves of 2,500,000 tons, and will

[3] Avery, W. M., Georgia Firm's New Flotation Plant Shows High Barite Recovery Index: Pit and Quarry, vol. 39, No. 4, October 1946, pp. 76–77.

Principal producers of barite in the United States in 1946

Name and address	Mine or mill location (nearest town)	Method of recovery
ARIZONA		
Arizona Barite Co., box 926, Mesa	Mesa	Shot from veins.
ARKANSAS		
Baroid Sales Division, National Lead Co., 830 Ducommun St., Los Angeles 12, Calif.	Malvern	Flotation.
Magnet Cove Barium Corp., Malvern	do	Do.
CALIFORNIA		
Barium Products, Ltd., Newark	Greenville	Shot from veins.
Baroid Sales Division, National Lead Co., 830 Ducommun St., Los Angeles 12.	El Portal	Do.
GEORGIA		
Barytes Mining Co., Box 224, Cartersville [1]	Cartersville	Washer.
New Riverside Ochre Co., Cartersville	do	Do.
Paga Mining Co., Cartersville	do	Do.
MISSOURI		
Apex Mining Co., Inc., Potosi	Mineral Point	Do.
Baroid Sales Division, National Lead Co., 830 Ducommun St., Los Angeles 12, Calif.	Potosi	Do.
Do	Richwoods	Do.
Barytes Mining Co., Potosi	Potosi	Do.
Cadet Mining Co., Cadet	Mineral Point	Do.
Campbell Bros., Russellville	Cole Camp	Do.
J. E. Carter Mining Co., Potosi	Potosi	Do.
Wm. Craig Mining Co., Cole Camp	Cole Camp	Do.
Degonia & Cole Mining Co., Potosi	Potosi	Do.
J. R. Dellinger, Potosi	do	Do.
De Soto Mining Co., De Soto	Richwoods	Do.
H. & P. Mining Co., Potosi	Old Mines	Do.
Fred Hornsey & Co., Potosi	Potosi	Do.
A. H. Long, Cadet	Cadet	Do.
Midwest Mining Co., 2001 Lynch Ave., East St. Louis, Ill.	Richwoods	Do.
Potosi Mining Co., Potosi	Potosi	Do.
Reynolds & Dickey Mining Co., Potosi	Blackwell	Do.
Lloyd Sestak, Henley	Henley	Do.
Star Mining Co., Potosi	Old Mines	Do.
Superior Mineral Co., Cadet	Cadet	Do.
Do	Richwoods	Do.
Whaley & Scott Mining Co., Potosi	Potosi	Do.
L. A. Wood, Box 72, Sweetwater, Tenn	do	Do.
NEVADA		
Barium Products, Ltd., Newark, Calif	Battle Mountain	Shot from veins.
California-Nevada Barytes Mines, Division of the Glidden Co., 766 50th Ave., Oakland, Calif.	Argenta	Do.
TENNESSEE		
Clinchfield Sand & Feldspar Corp., 618 Mercantile Trust Bldg., Baltimore 2, Md.	Del Rio	Do.
Dellinger & Duckett, R. F. D. 2, Niota	Athens	Washer.
Sweetwater Mining Co., Sweetwater	Sweetwater	Do.
B. C. Wood, Sweetwater	do	Do.
L. A. Wood, Sweetwater	do	Do.

[1] Moved to Missouri.

Crude barite (domestic and imported) used in the manufacture of ground barite and barium chemicals in the United States, 1942–46, in short tons

Year	In manufacture of—			Total	Year	In manufacture of—			Total
	Ground barite [1]	Litho-pone	Barium chemicals			Ground barite [1]	Litho-pone	Barium chemicals	
1942	200,443	144,821	104,160	449,424	1945	482,442	139,288	99,173	720,903
1943	225,154	129,493	99,097	453,744	1946	465,468	154,166	102,439	722,073
1944	360,045	134,597	100,921	595,563					

[1] Includes some crushed barite.

continue shipments to the West coast oil well drillers from that source. Reserves at National Lead's Spanish mine in Nevada County, Calif., were estimated at 200,000 tons, some of which might not be minable. National Lead's mining costs in Missouri averaged $7.46 a short ton, not including administrative costs and taxes, according to Hester. The average selling price is $8.74. National Lead's net profit was estimated at 60 cents a ton. Another witness, Judge E. Eversole, estimated the average profit for most of the Missouri producers at 30 to 40 cents a ton, and stated that the investment in a Missouri washer ranged from $30,000 to $75,000. Gordon Young, testifying for the Magnet Cove Barium Corp., stated that the investment of his firm in plant and equipment was $650,000. M. C. Tarver, representing Georgia producers, said that the cost of mining a long ton of barite in that State was $8.51 ($7.60 a short ton) and that the higher cost over Missouri mining was accounted for by the necessity of removing extensive overburden before the shovel could start digging barite-bearing clay. The reserve position of the United States with respect to barite is probably better today than at any time during the past 10 years. According to testimony given before the committee obout 40,000,000 tons of commercial-grade barite have been blocked aut (at least roughly) by producers.

The distribution of consumption of barite in the United States in 1946 was reported as follows (1945 in parentheses): For well drilling, 372,610 short tons (407,871); for lithopone, 154,166 (139,288); for chemicals, 102,439 (99,173); for glass, 29,181 (25,761); for paint filler, 26,000 (21,000); for rubber filler, 20,000 (10,000); and for other purposes, including grinding losses, 17,677 (17,810); total, 722,073 (720,903). These figures include both foreign and domestic barite and are therefore more comprehensive than data published by the Bureau of Mines each quarter on domestic barite only.

PRICES

There was no immediate reaction when the Office of Price Administration removed price ceilings on crude and ground barite on November 9, 1946. Price ceilings in Georgia had ranged up to $11.50 a long ton for chemical-grade material, and on the whole these levels were maintained for the remainder of the year. Similarly, no change was reported in the Missouri price, which has been $8.50 a short ton, premium-penalty basis, since July 1944.

FOREIGN TRADE

Barite imported for consumption in the United States, by countries, 1942–46 [1]

	1942		1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Crude barite:								
Brazil			2	$25				
Canada	4,088	$31,490	67,126	456,088	49,487	$327,242	44,109	$268,839
Cuba	592	3,266			2,307	29,417		
Mexico			760	3,551	5,100	25,952	553	5,428
	4,680	34,756	67,888	459,664	56,894	382,611	44,662	274,267
Ground barite:								
Canada			6,660	176,287	1	15		
Cuba			5,304	67,630				
			11,964	243,917	1	15		

[1] No imports of barite in 1943.

WORLD REVIEW

World production of barite, 1940–46, by countries, in metric tons [1]

[Compiled by B. B. Mitchell]

Country [1]	1940	1941	1942	1943	1944	1945	1946
Algeria	(2)	2,580	2,753	2,988	1,340		8,237
Argentina	2,680	4,174	7,083	11,009	(2)		(2)
Australia	5,047	4,990	6,512	4,610	4,487	3,502	(2)
Austria	839	(2)	(2)	(2)	(2)	(2)	(2)
Belgium	(2)	290	550	170	300		(2)
Brazil	(2)	(2)	240	(2)	282	617	(2)
Canada	307	6,250	17,842	22,202	107,700	126,632	109,100
China [3]	18,000	18,000	18,000	(2)	(2)	(2)	(2)
Cuba	16,105	13,223	[4] 3,787	[4] 3,158	[4] 4,787	[4] 2,094	
Egypt	61	30	60	76	59	54	(2)
Eire	(2)	(2)	(2)	5,485	10,519	16,714	(2)
France	2,246	4,494	9,563	18,290	9,575	11,431	26,424
Germany:							
Baden	29,119	40,895	44,156				
Bavaria	47,405	25,792	27,537				
Prussia [5]	251,070	267,300	258,602	340,000	320,000	(2)	(2)
Saxony	67	15	25				
Thuringia	13,361	10,699	9,357				
India	19,079	23,844	11,462	9,002	15,545	25,051	(2)
Indochina	185	274	100			(2)	(2)
Italy	31,870	26,032	37,601		(2)	(2)	(2)
Japan	[6] 13,161	[6] 14,252	[6] 15,345	[6] 15,642	[6] 12,049	[6] 7,540	581
Korea (Chosen)	17,604	15,475	11,693	10,099	5,640	(2)	(2)
Peru	(2)	(2)	(2)		2,352	4,240	(2)
Portugal	20	46	(2)	1	(2)		(2)
Southern Rhodesia	390	1,067	2,675	1,256	13		173
Spain	9,936	8,125	7,801	6,309	7,491	9,877	(2)
Swaziland						79	224
Switzerland			256	268	233		(2)
Tunisia				72	76	68	(2)
Union of South Africa	691	1,390	745	2,740	3,201	2,209	2,191
United Kingdom [7]	126,331	103,167	100,312	102,736	100,422	94,711	(2)
United States	354,219	438,523	408,116	389,451	467,321	628,068	657,908

[1] In addition to the countries listed, barite is produced in Czechoslovakia, Greece, Mexico, Norway, U. S. S. R., and Yugoslavia, but data on production are not available.
[2] Data not available.
[3] Estimate.
[4] Exports.
[5] Official figures which, it is reported, cover only output of mines included under the mining law.
[6] Preliminary data for the fiscal year ended Mar. 31 of year following that stated.
[7] Includes witherite.

Canada.—Since 1941 Canadian Industrial Minerals has been mining barite at Walton, Nova Scotia, on the Bay of Fundy. For the first few years, oil-well drillers in Trinidad and South America were the largest outlets for production. In 1942, and again in 1944 and 1945, however, sizable shipments were made to the barium chemicals industry in the United States. In 1945 Canada asked for a reduction on the United States tariff to expand the United States markets for Canadian barite still further, and at the hearings on January 20, 1947, the proposed cut was protested by domestic producers. Nova Scotia barite can be landed in Grasselli, N. J., for less than $14 a short ton, including duty, whereas Georgia barite costs $10.25 per short ton at Cartersville, plus $5.89 freight to Grasselli; total, $16.14 delivered at Grasselli. Production at Walton was about 114,000 short tons in 1946, approximately the same as in 1945. The company has completed the sinking of a vertical shaft for the purpose of developing the ore body below the present quarry-floor levels.[4]

Growth of the Canadian barite industry is shown in the accompanying world production table. Almost all the output is accounted for by Canadian Industrial Minerals.

Woodhall Mines, Ltd., in the Nighthawk Lake area of the Porcupine mining district (northern Ontario) began shipments in May 1946. The barite is white; the f. o. b. mine price was stated to be $10 a long ton, with costs of production $3.50 a ton. Two veins, one 4¾ feet and the other 6½ feet wide, are reported on the property. The present proved depth of 450 feet indicates a minimum of 275,000 tons in a 500-foot length of the No. 1 vein. Geological investigations indicate that the depth of the veins may exceed 1,000 feet.[5]

The remainder of the Canadian barite output comes from a small mine at Parson, B. C.

Brazil.—In his testimony before the Committee for Reciprocity Information, Tariff Commission (see above), Walter Hester of the National Lead Co. announced that his firm and the Thompson-Weinman Co. of Cartersville, Ga., had formed a partnership to recover barite on the island of Camamu, off the coast of Brazil, 80 miles south of Salvador, Baía. The plant, which grinds and bags barite for the well-drilling trade in Venezuela, Colombia, and Trinidad, opened January 27, 1946.[6] Reserves are estimated at a million tons or more. Material produced in March 1946 analyzed 92.5 percent barium sulfate, 0.25 percent moisture, and the remainder silica, iron oxide, and alumina. Average specific gravity is 4.3, and 97.5 percent of the ground product passes a 300-mesh screen. Plant capacity is rated at 42,000 tons a year. The barite is quarried at the rate of 120 metric tons a day. About 200 workmen are employed at the quarry, mill, and docks. In 1944, 282 tons and 617 tons in 1945, were sold from the deposit. From February 1 to May 1, 1946, 3,300 tons were mined, milled, and bagged.

Italy.—For many years modest amounts of barite have been produced as a paint filler in Italy; but the industry, which employed some 700 people, ceased operations entirely during the 1943 invasion.[7]

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[4] Canadian Mining Journal, vol. 68, No. 2, February 1947, p. 112.
[5] Bureau of Mines, Mineral Trade Notes: Vol. 23, No. 5, November 1946, p. 30.
[6] Work cited in footnote 5.
[7] Bureau of Mines, Mineral Trade Notes: Vol. 22, No. 2, February 1946, pp. 26–28.

In January 1946 it was reported that stocks were negligible and reserves virtually undetermined. However, it was believed that the mines could resume operations at prewar levels within 6 months if fuel and supplies were made available. The year of greatest recorded production was 1939, with 53,893 metric tons, of which the Trento mining district, comprising three mines, supplied over half. Other contributing districts, in the order of importance, were the Iglesias, Milano, Padova, and Carrara. After Sardinia was captured by Allied forces, the possibility of obtaining barite from this island was investigated. However, Don Kingery's reports [8] described the workings as primitive and located mostly in isolated, inaccessible areas.

Japan.—The Natural Resources Section, Supreme Commander for the Allied Powers, issued Report 67, Barite Resources of Japan, in February 1947. According to the report, a peak output of 15,642 metric tons was reached in 1943, though prior to 1935 nearly all needs, which were of the order of 10,000 tons annually, were imported, mostly from Korea. Two mines in barite-quartz veins contributed about 90 percent of production. Mines and mills were small and methods crude.

Union of South Africa.—A new deposit of barite in Swaziland is now being worked by Swaziland Barytes, Ltd.[9] Reserves are estimated at over 200,000 tons, of which 1,000 have been mined, and some exported. An unusual feature of the beneficiation is the removal of a crust of iron oxide from the "ore" surface with a sand blast.

United Kingdom.—The British barite and witherite industries were described by Dunham, Dines, and others.[10] During the 5-year period 1939–43, an average of 86,000 long tons of barite and witherite was produced annually in England and Wales. The prewar (1936) price of crude barite was 27.3 shillings per long ton, at mine, which compares with a wartime high of 70 shillings. Six barite mines operate in the Northern Pennine ore field, extending from the Tyne Valley (Northumberland) southward to the Craven district of West Yorkshire, including parts of Durham, Cumberland, and Westmoreland. Two producers of barite are in the Northumberland and Durham coal field, and deposits are being worked in various other districts of England and Wales. Witherite is less widespread, being found in the Tyne Valley near Haydon Bridge in the Durham coal field and near Alston, both in northeast England.

BARITE—GROUND (AND CRUSHED)

SALES

As usual, the major use of ground barite was in oilwell drilling. This outlet took 82 percent of production, compared with 86 percent in 1945. Among the smaller uses of ground and crushed barite, increased shipments to the rubber industry were noted—1946 sales being double those of 1945.

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[8] Bureau of Mines, Mineral Trade Notes: Vol. 22, No. 2, February 1946, pp. 28–34.
[9] Mehliss, A. T. M., Barytes in Swaziland: South African Min. Jour., vol. 57, No. 2,786, July 6, 1946, pp. 465, 467.
[10] Dunham, K. C., Dines, H. G., and others, Barium Minerals in England and Wales: Geol. Survey Great Britain, Dept. of Scientific and Industrial Research, Wartime Pamphlet 46, September 1945, 149 pp.

Ground (and crushed) barite produced and sold by producers in the United States, 1943–46 [1]

Year	Plants	Production (short tons)	Sales	
			Short tons	Value
1943	18	215,464	208,252	$3,743,919
1944	19	344,377	344,757	5,455,835
1945	20	473,749	468,939	7,519,759
1946	23	456,327	455,240	7,208,193

[1] Barite used in chemicals, although crushed before use, is not included in 1945 and 1946 totals. In 1944 and prior years small quantities of crushed barite used by chemical producers are included.

Much of the ground barite reported for use in paint and rubber is bleached; it is also used as a white filler in wall paper, printing ink, and plastics. Unbleached, or "off-color," ground barite is used in linoleum, phonograph records, dark paints, and other products where color is immaterial.

Ground (and crushed) barite sold by producers, 1944–46, by consuming industries [1]

Industry	1944		1945		1946	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Well drilling	277,792	80	407,871	87	372,610	82
Paint	23,000	7	21,000	4	26,000	6
Glass	24,153	7	25,761	6	29,181	6
Rubber	10,000	3	10,000	2	20,000	4
Undistributed	9,812	3	4,307	1	7,449	2
	344,757	100	468,939	100	455,240	100

[1] Barite used in chemicals, although crushed before use, is not included in 1945 and 1946 totals. In 1944 and prior years small quantities of crushed barite used by chemical producers are included.

In the accompanying table, figures for consumption of ground barite in "Paint," "Rubber," and "Undistributed" have been estimated partly by the grinders and partly by the Bureau of Mines.

An average of 5 tons of barite is used per 1,000 feet of oil wells drilled in high-pressure formations. The barite eventually is lost because the mud acquires too much clay cuttings, which raises viscosity and lowers density, and the whole is discarded. From the West coast is reported a possible method of recovering a good portion of barite from well-drilling muds.[11] The mud is diluted with water to reduce viscosity and gel strength, and the mass is centrifuged. The light mud can thus be separated. Efficiency is said to be 85 to 95 percent.

PRICES

Price ceilings on ground and crushed barite were removed by the Office of Price Administration on July 26, but little change was noticed in quotations during the rest of the year. Glass-grade barite was quoted generally at $15.50 a short ton, bulk, with $2 a ton extra

[11] Lindsay, C. A., Recovery of Barite from Rotary Drilling Mud by Centrifugal Separation: Oil and Gas Jour., vol. 45, No. 23, October 12, 1946, p. 91.

for packing in 100-pound bags. Well-drilling grades of ground barite averaged $15.15 a short ton, bulk, f. o. b. mine, according to reports of grinders to the Bureau of Mines.

According to the Oil, Paint and Drug Reporter, ground bleached barite was quoted at $31.10 a short ton in bags, carlots, St. Louis, Mo.—an increase of $3.45 over the 1945 price of $27.65.

FOREIGN TRADE

Data on imports of ground barite are shown in the Foreign Trade portion of the Primary Barite section of this chapter.

WITHERITE

In 1946 increased quantities of witherite were imported from Great Britain, the world's sole commercial source, for use in brick descumming and steel carburizing. Witherite is not produced in the United States, except as it may be mined mixed with barite.

Witherite, crude, unground, imported for consumption in the United States, 1942–46

[Value at port of shipment]

Year	Short tons	Value	Year	Short tons	Value
1942	3,066	$60,824	1945	896	$26,736
1943	448	9,452	1946	1,107	31,599
1944					

According to Oil, Paint and Drug Reporter, witherite, 99 percent through 200-mesh, bags, carlots, works, was quoted at $43 a short ton in 1946, the same as in 1945.

BARIUM CHEMICALS

PRODUCTION

Production and sales of all the principal barium chemicals showed notable increases in 1946 as compared with 1945. Production of barium carbonate was up 7 percent, chloride 9 percent, hydroxide 30 percent, oxide 4 percent, and sulfate 11 percent. The reconversion problems of the industry were solved during the year, and the industry served expanding peacetime markets. The carbonate is now used mostly in brick descumming and oil-well drilling rather than as an intermediate for other barium chemicals used in flares and explosives. Barium nitrate, used almost exclusively in war materials, was made by one firm only, and production cannot be shown separately. The oxide is used mostly in ceramics. Barium sulfate is a well-known paint extender and is also used in photographic paper, printing inks, and as a filler in linoleum, oil cloth, wallpaper, and other materials.

This chapter for 1945 carried a table showing consumption (partly estimated) of the three principal barium chemicals—the carbonate, chloride, and sulfate.

Like other pigment trends, lithopone output was up in 1946. It is used mostly in paints, as may be noted in the accompanying table.

Barium chemicals produced and used or sold by producers in the United States, 1942–46, in short tons

Chemical	Plants	Produced	Used by producers [1] in other barium chemicals [2]	Sold by producers [3]	
				Short tons	Value
Black ash: [4]					
1942	18	163,119	163,043	950	$41,275
1943	18	148,179	147,975	553	23,969
1944	17	153,624	153,573	371	16,316
1945	15	149,871	149,203	257	10,490
1946	15	163,131	162,889	505	22,876
Carbonate (synthetic):					
1942	7	30,204	14,724	14,905	830,034
1943	5	35,308	21,513	13,979	753,832
1944	5	37,911	27,551	9,313	467,288
1945	5	40,689	25,139	15,287	905,402
1946	5	43,611	21,569	21,700	1,313,233
Chloride (100 percent basis):					
1942	3	13,439	1,722	11,497	913,290
1943	3	15,379	5,111	10,545	942,399
1944	3	17,183	5,766	11,446	955,571
1945	3	14,766	4,743	9,562	831,072
1946	3	16,037	4,974	10,821	927,155
Hydroxide:					
1942	4	3,368	66	3,202	366,472
1943	4	3,444	54	3,398	337,107
1944	3	2,462	98	2,429	244,072
1945	3	2,334	123	2,135	242,124
1946	3	3,024	585	2,503	320,474
Nitrate:					
1942	5	11,547	----------	11,489	2,262,061
1943	5	12,157	----------	12,324	2,376,631
1944	3	11,160	----------	11,333	2,066,976
1945	2	(5)	----------	(5)	(5)
1946	1	(5)	----------	(5)	(5)
Oxide:					
1942	3	3,922	3,543	155	30,752
1943	3	5,189	4,998	170	37,925
1944	3	4,748	4,638	84	19,158
1945	3	6,253	5,965	260	52,057
1946	3	6,507	6,105	375	64,522
Peroxide:					
1942	3	3,054	1,803	1,223	289,187
1943	3	4,123	1,682	2,495	563,756
1944	2	(5)	(5)	(5)	(5)
1945	2	(5)	(5)	(5)	(5)
1946	2	(5)	(5)	(5)	(5)
Sulfate (synthetic):					
1942	6	25,779	17,194	8,324	512,969
1943	7	24,606	13,087	12,028	752,089
1944	8	30,804	18,720	11,340	790,366
1945	8	30,822	17,602	12,856	922,902
1946	8	34,171	16,956	18,791	1,330,651
Other barium chemicals: [6]					
1942	(7)	24,539	----------	21,487	2,384,282
1943	(7)	22,831	----------	22,831	2,557,714
1944	(7)	30,111	2,904	27,275	3,180,939
1945	(7)	[8] 36,428	4,405	[8] 27,727	[8] 3,529,401
1946	(7)	28,880	4,395	26,176	3,024,845
Total: [9]					
1942	23	----------	----------	73,232	7,630,322
1943	24	----------	----------	78,323	8,345,422
1944	22	----------	----------	73,591	7,740,686
1945	19	----------	----------	[8] 68,084	[8] 6,493,448
1946	19	----------	----------	80,871	7,003,756

[1] Of any barium chemical.
[2] Includes purchased material.
[3] Exclusive of purchased material and exclusive of sales by one producer to another.
[4] Black-ash data include lithopone plants.
[5] Included under "Other barium chemicals."
[6] Consists mostly of titanium dioxide-barium sulfate pigments, with small quantities of barium acetate, chromate, nitrate, oxide, perchlorate, peroxide, and sulfide. Specific chemicals may not be revealed by specific years.
[7] Plants included in above figures.
[8] Revised figure.
[9] A plant producing more than 1 product is counted but once in arriving at grand totals.

Lithopone [1] sold or used by producers in the United States, 1942–46

	1942	1943	1944	1945	1946
Plants	9	9	8	8	8
Short tons	137,320	135,723	142,905	136,161	147,001
Value	$10,828,924	$10,745,305	$11,208,891	$10,645,316	$11,840,596

[1] Exclusive of cadmium lithopone.

Lithopone [1] sold or used by producers, 1944–46, by consuming industries

Industry	1944		1945		1946	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Paints, enamels, and lacquers	108,800	76	109,398	80	123,279	84
Floor coverings and textiles	14,746	10	15,821	12	15,167	10
Rubber	726	1	977	1	1,607	1
Other	18,633	13	9,965	7	6,948	5
	142,905	100	136,161	100	147,001	100

[1] Exclusive of cadmium lithopone.

PRICES

Range of quotations on barium chemicals, 1944–46

[Oil, Paint and Drug Reporter]

	1944	1945	1946
Lithopone:			
Ordinary, bags, at New York, pound	$0.04¼–$0.04¾	$0.04¼–$0.04¾	$0.04¼–$0.05
Ordinary, barrels, at New York, do	.04½	.04½	.04½– .05¼
Titanated, bags, do	.056	.056	.056 – .06¾
Titanated, barrels, do	.0585	.0585	.0585– .07¼
Barium carbonate, precipitated, 200-pound bags, carlots, works, short ton	55.00 –70.00	60.00 –70.00	60.00 –70.00
Barium chlorate, 112-pound kegs, works, pound	.36	.27½– .31	.27½– .31
Barium chloride, technical, crystals, barrels, carlots, works, short ton	75.00 –90.00	75.00	75.00
Barium peroxide, drums, carlots, works, pound	.10 – .13	.10 – .13	.10
Barium hydrate, crystals, barrels, works, do	.06 – .07	.06 – .07	.06 – .07½
Barium nitrate, barrels, carlots, works, do	.10 – .12	.09½– .11½	.09½– .11½
Blanc fixe (dry):			
Direct process, bags, carlots, works, short ton	70.00	70.00	70.00
Byproduct, bags, carlots, works, do	60.00	60.00	60.00

FOREIGN TRADE

Barium chemicals imported for consumption in the United States, 1942–46

[Value at port of shipment]

Year	Lithopone		Barium dioxide		Blanc fixe (precipitated barium sulfate)		Barium chloride	
	Short tons	Value	Pounds	Value	Short tons	Value	Short tons	Value
1942			40,992	$2,119	28	$1,357	36	$15,770
1943							18	7,885
1944								
1945	(1)	$7						
1946	(2)	58						

Year	Barium nitrate		Barium hydroxide		Other barium compounds	
	Short tons	Value	Short tons	Value	Short tons	Value
1942	(3)	$1	147	$9,361	154	$76,667
1943			151	9,850	43	15,385
1944			95	7,382		
1945			35	3,091		
1946						

[1] 75 pounds. [2] 1,000 pounds. [3] 53 pounds.

Lithopone exported from the United States, 1942–46

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1942	17,036	$1,733,698	$101.77	1945	11,576	$1,049,961	$90.70
1943	17,320	1,637,217	94.53	1946	9,651	888,555	92.07
1944	11,551	1,107,430	95.87				

Bauxite

By HUBERT W. DAVIS AND MARY E. TROUGHT

GENERAL SUMMARY

DOMESTIC mine production of crude bauxite in 1946 reversed a 2-year downward trend and increased to 1,316,395 long tons (1,072,825 tons, dried equivalent), a gain of 15 percent over 1945. Arkansas supplied 95 percent of the total domestic output in 1946.

Imports of bauxite were larger for the second consecutive year and totaled 852,005 tons in 1946, also a 15-percent gain over 1945. Surinam was the source of 94 percent of the imports in 1946. Exports of bauxite dropped for the third successive year and totaled 97,788 tons in 1946, a decline of 22 percent from 1945. Canada continued to be the largest recipient of the exports.

Consumption of bauxite in the United States decreased 22 percent to 1,889,156 tons (dried equivalent) in 1946, compared with 2,433,412 tons in 1945. Of the 1946 total, the alumina industry used 80 percent.

Salient statistics of the bauxite industry in the United States, 1943–46

	1943	1944	1945	1946
Production (crude ore) [1]—long tons	6,232,883	2,823,724	981,009	1,072,825
Value of production [2]	$30,659,900	$14,402,497	$5,591,084	$6,709,164
Imports [2]—long tons	1,547,854	560,461	739,581	852,005
Exports (including concentrates) [2]—do	417,186	146,638	126,077	97,788
World production [2]—do	13,914,000	7,024,000	3,642,000	3,937,000

[1] Dried equivalent of mine production.
[2] As shipped.

Stocks of bauxite (dried equivalent) at mines and processing plants were 448,790 long tons on December 31, 1946, an 11-percent increase over those at the end of 1945, but consumers' stocks dropped 40 percent to 252,977 tons. Stocks of bauxite held by the Office of Metals Reserve on June 30, 1946, were declared surplus and transferred to the Bureau of Federal Supply.

World production of bauxite is estimated at 4,000,000 metric tons in 1946, an 8-percent gain over 1945. About 70 percent of the 1946 world total is estimated to have been mined in the United States and the Guianas.

Aluminum metal is discussed in the Aluminum chapter of this volume.

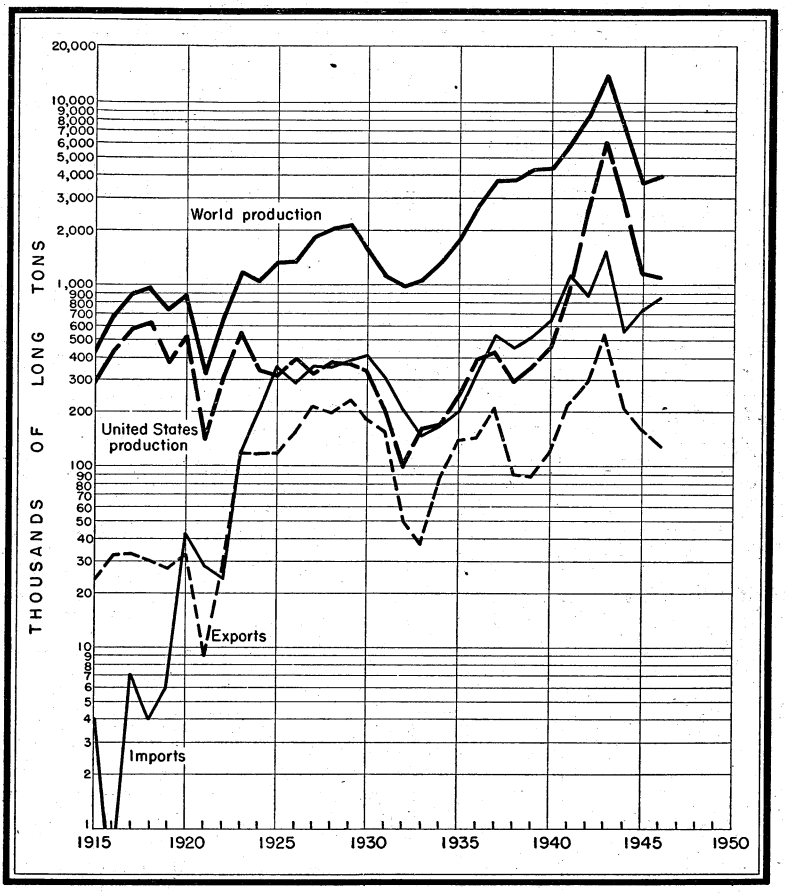

FIGURE 1.—Trends in domestic production, imports, exports, and world production of bauxite, 1915–46.

PRODUCTION

Despite a decline of 17 percent in the output of aluminum, a 92-percent drop in shipments of bauxite to the Office of Metals Reserve, and a larger excess of imports over exports, domestic mine production of crude bauxite reversed a 2-year downward trend and increased to 1,316,395 long tons (1,072,825 tons, dried equivalent) in 1946, a gain of 15 percent over 1945. Production in Alabama, Arkansas, and Virginia was 7, 18, and 234 percent, respectively, greater than in 1945, but output in Georgia was 41 percent smaller.

Alabama.—The Alcoa Mining Co. and the D. M. Wilson Bauxite Co. produced bauxite from deposits in the Eufaula district, Barbour and Henry Counties, in 1946. The mines of the Alcoa Mining Co. are served by a drying plant, from which dried bauxite was shipped chiefly to the chemical and refractory industries in 1946. The D. M. Wilson Bauxite Co. shipped crude bauxite to Quincy, Fla., where the Floridin Co. has an activating plant; the activated bauxite was shipped chiefly to petroleum refining industries.

Production and shipments of crude bauxite from mines in the United States, 1942–46, by States, in long tons

State and year	Production			Shipments to processing plants, consumers, and Government stock piles		
	Crude	Dried bauxite equivalent	Value	Crude	Dried bauxite equivalent	Value f. o. b. mine
Alabama, Georgia, and Virginia:						
1942 [1]	166,884	142,128	$808,900	165,495	141,988	$801,660
1943	229,607	196,393	1,227,600	224,369	192,669	1,193,759
1944	149,434	128,407	723,470	153,999	132,362	751,557
1945	83,326	70,960	394,157	84,890	72,311	395,717
1946	64,371	53,707	314,594	65,026	54,206	318,516
Arkansas:						
1942	2,852,051	2,459,906	12,172,500	2,712,732	2,337,784	11,576,098
1943	7,053,028	6,036,490	29,432,300	6,825,911	5,818,508	28,487,923
1944	3,173,008	2,695,317	13,679,027	3,128,588	2,657,463	13,465,057
1945	1,061,911	910,049	5,196,927	1,247,766	1,073,349	5,591,630
1946	1,252,024	1,019,118	6,394,570	1,282,099	1,044,939	6,546,469
Total United States:						
1942	3,018,935	2,602,034	12,981,400	2,878,227	2,479,772	12,377,758
1943	7,282,635	6,232,883	30,659,900	7,050,280	6,011,177	29,681,682
1944	3,322,442	2,823,724	14,402,497	3,282,587	2,789,825	14,216,614
1945	1,145,237	981,009	5,591,084	1,332,656	1,145,660	5,987,347
1946	1,316,395	1,072,825	6,709,164	1,347,125	1,099,145	6,864,985

[1] Includes Mississippi.

Bauxite shipped from mines and processing plants in the United States, 1942–46, by States, in long tons

Year	Alabama, Georgia, and Virginia		Arkansas		Total	
	As shipped [1]	Dried bauxite equivalent	As shipped [1]	Dried bauxite equivalent	As shipped [1]	Dried bauxite equivalent
1942	[2] 150,006	[2] 137,199	2,391,596	2,311,283	2,541,602	2,448,482
1943	188,842	182,350	6,348,478	5,765,491	6,537,320	5,947,841
1944	132,533	129,568	2,788,019	2,568,770	2,920,552	2,698,338
1945	77,134	80,567	988,877	991,227	1,066,011	1,071,794
1946	52,505	53,829	1,049,125	964,945	1,101,630	1,018,774

[1] Includes crude, dried, calcined, activated, and sintered.
[2] Includes Mississippi.

Arkansas.—Production of bauxite at the Drury mine near Sweet Home, Pulaski County, operated by the Alcoa Mining Co., tripled that of 1945. About one-fourth of the output was sold to the nearby Drury calcining plant of its affiliate, Aluminum Ore Co., which calcined the ore for sale to the abrasive industry; the remainder of the production was sold to other local processors. At its mines in Saline County the Alcoa Mining Co. produced 2 percent less bauxite than in 1945. Numerous underground and open-pit mines were operated by the company in the vicinity of Bauxite, where it has facilities for drying and calcining ore which is sold to alumina, chemical, abrasive, and other plants.

The Crouch Mining Co. mined high-grade ore from its Young mine in Saline County and processed the entire output in its drying and calcining plant near Bauxite. Production was 16 percent less in 1946 than in 1945; the output was shipped to abrasive plants.

The Berger No. 100 was the only mine worked by the American Cyanamid Co. in Arkansas in 1946. The ore from the Berger No. 100 mine, together with ore from stock at its inactive Rauch Leased and Heckler mines in Pulaski County and Townsend mine in Saline County and some purchased ore, was dried at the company rotary, gas-fired plant near Berger and the dried bauxite shipped to the chemical and petroleum-refining industries. Production of ore by the company in Arkansas was 76 percent less than in 1945 but shipments of dried bauxite were only 14 percent smaller.

The Norton Co. produced 4 percent less bauxite in 1946 than in 1945. This ore, together with purchased ore, is calcined for the abrasive industry. Shipments of calcined bauxite were 12 percent smaller than in 1945.

In 1946 the Dulin Bauxite Co. operated the Penzel-Coe, Dixie, and Vinson-Hoffman mines and its calcining plant near Sweet Home, Pulaski County; it shipped calcined bauxite to the abrasive and other industries and ore to the Office of Metals Reserve. Shipments of calcined bauxite were 13 percent less than in 1945, but those of ore were 7 percent more.

The Pulaski Mining Co. at its Rummell mine in Pulaski County made a small output, two-thirds of which was sold to a local processor and the remainder to the chemical industry.

The Reynolds Mining Corp. operated the Fletcher, Hurricane Creek, Covington Whitley, and Stuckey mines in Saline County and the Buzbee mine in Pulaski County in 1946. Production by the company was 64 percent larger than in 1945. The entire output was sold to its affiliate, Reynolds Metals Co.

The Porocel Corp. operated its plant at Berger, Pulaski County, where bauxite is milled, activated, and purified by magnetic separation; it also operates a plant at the same location where activated bauxite is impregnated with chemicals for use as a catalyst. The company purchases almost all of its requirements of bauxite from local producers.

The beneficiation of low-grade Arkansas bauxites has been described by Runke and O'Meara.[1]

Georgia.—The American Cyanamid Co. and Alcoa Mining Co. continued to operate mines and drying plants in Georgia in 1946. The former company worked the Hatton and Thig Pen mines in the Andersonville district, Sumter County; output was 29 percent less than in 1945. The Alcoa Mining Co. operated mines in the Hermitage area of Floyd County until March, when operations were discontinued; output was 92 percent smaller than in 1945. All ore was shipped to the alumina and chemical industries in dried form.

Virginia.—The Alcoa Mining Co. worked the Lightner, Allen, and Harris mines near Spottswood, Augusta County, in 1946. Output was more than double that of 1945 and was shipped to the chemical and refractories industries in crude form. These mines were closed on December 31, 1946.

[1] Runke, S. M., and O'Meara, R. G., Concentration of Bauxite for Milling in the 50-Ton Bureau of Mines Pilot Plant, Bauxite, Ark.: Bureau of Mines Rept. of Investigations 3909, 1946, 25 pp.

Recovery of processed bauxite in the United States, 1942–46, in long tons

Year	Crude ore treated	Processed bauxite recovered			
		Dried	Activated, calcined, or sintered	Total	Dried bauxite equivalent
1942	1,734,761	1,212,964	166,058	1,379,022	1,458,374
1943	2,546,849	1,904,328	344,187	2,248,515	2,402,401
1944	1,408,344	964,613	152,465	1,117,078	1,188,869
1945	874,180	522,533	132,525	655,058	719,416
1946	708,964	426,618	111,312	537,930	597,509

Bauxite shipped from mines and processing plants in the United States, 1943–46, by consuming industries, in long tons

Industry	1943		1944		1945		1946	
	As shipped [1]	Dried bauxite equivalent	As shipped [1]	Dried bauxite equivalent	As shipped [1]	Dried bauxite equivalent	As shipped [1]	Dried bauxite equivalent
Alumina [2]	6,075,631	5,404,159	2,628,481	2,335,137	816,776	760,782	872,311	732,972
Chemical	244,446	241,851	128,503	127,526	98,664	97,029	109,496	109,153
Abrasive [3]	178,341	258,381	143,389	209,135	117,493	174,338	98,670	146,868
Petroleum refining, refractory,[3] and other	38,902	43,450	20,179	26,540	33,078	39,645	21,153	29,781
Total: Long tons	6,537,320	5,947,841	2,920,552	2,698,338	1,066,011	1,071,794	1,101,630	1,018,774
Value	$33,372,382		$15,814,431		$7,386,337		$7,725,939	

[1] Includes crude, dried, calcined, activated, and sintered.
[2] Includes shipments to Office of Metals Reserve stock piles as follows:
1943—3,384,874 tons (2,852,773 dried equivalent).
1944—1,594,487 tons (1,332,673 dried equivalent).
1945—400,096 tons (339,052 dried equivalent).
1946—33,382 tons (28,375 dried equivalent.)
[3] Small quantity of bauxite shipped to makers of refractories probably included under "Abrasive."

RESERVES

The following information on reserves was prepared by Josiah Bridge, of the Geological Survey, and John B. Dorsh and John H. Weitz, of the Bureau of Mines, and has been taken from an unpublished report, The Mineral Position of the United States.

Reserves of high-alumina materials, exclusive of anorthosite, considered in 1944 as potential ores, totaled 3 billion tons containing 356 million short tons of recoverable aluminum. Of the latter quantity, only 3 percent, or about 11 million tons, was in material considered ore in 1944. In 1943 the United States actually used approximately 750,000 short tons of aluminum. A little over 2 percent, or 8 million tons, is in high-iron bauxite; 0.15 percent, or about 500,000 tons, in alunite; and 95 percent in low-grade bauxite, bauxitic clay, and high-alumina clay. The United States has very small reserves of grade I bauxite (not more than 7 percent SiO_2; not more than 3 percent FeO) which was used exclusively in this country for the production of aluminum before the war. Recent technologic advances probably have made grade II (not more than 15 percent SiO_2; not more than 6 percent FeO; not less than 40 percent Al_2O_3; and not less than 32 percent available alumina) bauxite commercially available, but known reserves are not large in terms of long-range national requirements. The Nation's aluminum resources in the lower-grade bauxites and clay are enormous, but it probably will be cheaper to import high-grade foreign ores than to extract alumina from low-grade domestic material. However, it provides an emergency source of supply that could be used

if supplies of the higher-grade bauxites are cut off at any time in the future. In an emergency, it could supply the entire national requirement for a considerable period if the increased cost of processing is not a controlling factor.

CONSUMPTION

Consumption of bauxite (dried equivalent) totaled 1,889,156 long tons in 1946 compared with 2,433,412 tons in 1945. The consumption figures for both years include calcined bauxite shipped for export to American-owned abrasive plants in Canada for the manufacture of crude abrasives, which are returned to the United States for final manufacture and consumption. Consumption of bauxite as shipped totaled 1,879,425 tons in 1946 and consisted of 461,052 tons of crude ore, 1,285,440 tons of dried ore, 124,222 tons of calcined ore, and 8,711 tons of activated ore. Of the bauxite consumed (dried-equivalent basis) in 1946, 52 percent was domestic and 48 percent foreign. Of the foreign ore consumed in 1946, the alumina industry used 92 percent and the chemical, abrasive, cement, and other industries absorbed the remaining 8 percent.

Bauxite consumed in the United States, 1945–46, by consuming industries, in long tons

[Dried-bauxite equivalent]

Industry	1945			1946		
	Domestic	Foreign	Total	Domestic	Foreign	Total
Alumina [1]	1,396,350	656,733	2,053,083	684,074	831,528	1,515,602
Chemical	96,845	37,921	134,766	96,306	43,527	139,833
Abrasive and refractory	187,355	13,827	201,182	182,582	22,798	205,380
Other	36,071	8,310	44,381	20,804	7,537	28,341
	1,716,621	716,791	2,433,412	983,766	905,390	1,889,156

[1] Includes some bauxite used in making chemicals and other products.

Alumina.—Bauxite consumption by the alumina industry in 1946 totaled 1,515,602 long tons (684,074 tons from domestic mines and 831,528 tons from foreign sources) compared with 2,053,083 tons in 1945. Of all the bauxite consumed in 1946, the alumina industry used 80 percent compared with 84 percent in 1945. The alumina industry employed crude and dried ore, chiefly from Arkansas, Georgia, Surinam, and British Guiana. Not all bauxite consumed by the alumina industry is destined to emerge finally as aluminum metal, since some of the alumina is used by the chemical, abrasive, and refractory industries and some of it is processed into special products, such as activated and tabular aluminas for use in the petroleum-refining and ceramic industries.

Chemical.—Bauxite consumption by producers of aluminum salts and alumina (nonmetallurgical) was 262,275 long tons (169,009 tons of domestic and 93,266 tons of foreign) in 1946 compared with 258,205 tons (211,273 tons of domestic and 46,932 tons of foreign) in 1945. In addition to bauxite, producers of aluminum salts reported consuming 19,882 short tons of aluminum trihydrate, 11,977 tons of secondary aluminum, 73,883 tons of clay, and a quantity of alunite and bichromate residues in 1946. The bauxite requirements for the chemical

industry were supplied chiefly from Alabama, Arkansas, Georgia, Virginia, Surinam, and British Guiana.

Production and shipments of aluminum salts increased 4 percent each in quantity and 2 percent in total value in 1946 over 1945. Output of alumina (aside from that used in making aluminum) increased 9 percent, and shipments gained 10 percent. Of this alumina, 28 percent was consumed by aluminum salts producers; the remainder was used by manufacturers of abrasives, refractories, petroleum products, spark plugs, glass, rubber, paints, and various other commodities.

Aluminum salts and alumina produced and shipped in the United States, 1945–46

	1945				1946			
	Production	Shipments			Production	Shipments		
	Short tons	Shippers	Short tons	Value	Short tons	Shippers	Short tons	Value
Aluminum salts:								
Alum:								
Ammonia	8,460	6	8,528	$579,583	7,551	5	7,391	$502,509
Potash	4,844	4	5,170	395,859	5,163	4	5,035	372,235
Aluminum chloride:								
Liquid	[1] 7,028	4	[1] 7,199	[1] 274,524	7,374	4	6,748	252,491
Crystal, Anhydrous	21,036	3, 7	20,892	2,929,033	17,812	3, 6	17,726	2,584,133
Aluminum sulfate:								
Commercial:								
General	545,209	19	540,030	11,825,418	568,345	18	569,435	12,491,270
Municipal	12,062	8	12,011	236,729	11,982	8	12,268	228,184
Iron free	29,731	6	29,400	1,053,104	32,791	6	30,730	1,063,299
Sodium aluminum sulfate, Sodium aluminate	28,842	2, 12	28,943	1,892,509	29,903	2, 10	30,323	2,015,360
Total aluminum salts	[1] 657,212	------	[1] 652,173	[1] 19,186,759	680,921	------	679,656	19,509,481
Alumina [2]	65,117	10	66,895	5,187,433	71,281	9	73,661	6,168,752

[1] Revised figure.
[2] Excludes alumina produced for use in making aluminum; includes activated, calcined, crude, light and heavy hydrate, converted to a calcined alumina equivalent.

Abrasive and Refractory.—Manufacturers of crude aluminous abrasive pigs in Canada and the United States and manufacturers of bauxite refractories in the United States used 205,380 tons (11 percent) of all the foreign and domestic bauxite consumed in 1946, a 2-percent increase over the 201,182 tons used in 1945. Except for a relatively small quantity from British Guiana, all the ore requirements of the industry were supplied from Alabama, Arkansas, and Virginia.

Other.—Consumption of bauxite in the cement, steel, ferro-alloy, and petroleum-refining industries decreased 36 percent in 1946 from 1945.

STOCKS

Stocks of bauxite (dried equivalent) on hand at mines and processing plants on December 31, 1946, totaled 448,790 long tons, compared with 403,268 tons on December 31, 1945. Stocks at consumers' plants decreased from 422,863 tons at the end of 1945 to 252,977 tons at the end of 1946. Government-owned stocks of bauxite held by Office of Metals Reserve were declared surplus on June 30, 1946, and transferred to the Bureau of Federal Supply.

Stocks of bauxite on hand December 31, 1942–46, in long tons

Year	Producers, crude	Processors		Consumers		Government, crude	Total	
		Crude	Processed [1]	Crude	Processed [1]		Crude and processed	Dried bauxite equivalent
1942	270,862	41,805	10,445	571,123	335,366	491,797	1,721,398	1,543,558
1943	494,182	60,727	6,767	861,497	750,481	2,855,896	5,029,550	4,413,456
1944	537,092	68,163	7,019	483,836	304,251	3,413,607	4,813,968	4,156,742
1945	346,463	119,788	5,277	126,643	296,486	3,244,707	4,139,364	3,584,132
1946	315,733	196,599	9,853	62,442	181,708	[2]	[3] 766,335	[3] 701,767

[1] Dried, calcined, activated, and sintered.
[2] Figure not available for publication.
[3] Excludes Government stocks.

PRICES

In 1946 the average selling price, f. o. b. mines and processing plants, was $5.10 a long ton for crude (undried) bauxite, $6.98 for crushed dried bauxite, $15.43 for calcined bauxite, and $48.81 for activated bauxite. Prices in 1945 were as follows: $4.49 for crude, $5.93 for dried, $14.29 for calcined, and $53.80 for activated. The weighted average price for all grades of domestic ore as shipped was $7.01 a long ton in 1946 ($6.93 in 1945). Nominal market quotations remained static throughout 1946 for all grades of domestic bauxite. Quotations on foreign bauxite ore have not been published in domestic trade journals since February 6, 1941.

Range of quotations on domestic bauxite, 1944–46, per long ton

[E&MJ Metal and Mineral Market Reports]

Type of ore	Chemical specifications (percent)		Prices		
	Al_2O_3	SiO_2	1944	1945	1946
Crude [1]	50–52	[2]	$5.00	$5.00	$5.00
Chemical, crushed and dried [3]	55–58	[4]	$7.50–8.50	$7.50–8.50	$7.50–8.50
Other grades [1]	56–59	5–8	7.50–8.50	7.50–8.50	7.50–8.50
Pulverized and dried [1]	56–59	8–12	14.00–16.00	14.00–16.00	14.00–16.00
Abrasive grade, crushed and calcined [1]	78–84	[4]	16.00	16.00	16.00

[1] F. o. b. Arkansas mines.
[2] Not specified.
[3] F. o. b. Alabama and Arkansas mines.
[4] SiO_2 not specified; Fe_2O_3, 1.5–2.5 percent.

FOREIGN TRADE [2]

Imports of bauxite increased for the second consecutive year and totaled 852,005 long tons in 1946, a gain of 15 percent over 1945. Of the 1946 imports, Surinam supplied 802,288 tons, British Guiana 40,595 tons, Curaçao 4,121 tons. Brazil 3,501 tons, and Jamaica 1,500 tons. By customs districts in the United States, 652,951 tons were received at Mobile, 133,263 at New Orleans, 33,325 at Philadelphia, 13,935 at New York, 10,152 at Maryland, 4,878 at Massachusetts, and 3,501 at Sabine. The duty on bauxite is $1 a long ton.

[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Bauxite and aluminum compounds imported into the United States, 1942–46

Year	Bauxite			"Alumina"		Aluminum compounds	
	As imported (long tons)	Dried bauxite equivalent (long tons)	Value	Long tons	Value	Short tons	Value
1942	884,217	884,217	$5,952,451	21,711	$1,570,377	(1)	$4
1943	1,547,854	1,541,929	10,860,149	12,372	1,108,104	3	941
1944	560,461	555,647	3,844,310	(2)	1		
1945	739,581	737,081	5,273,122	179	10,940		
1946	852,005	851,148	5,965,124	4	2,607	2	654

[1] 50 pounds.
[2] Less than 1 ton.

Exports dropped for the third successive year and totaled 97,788 long tons in 1946, a decline of 22 percent from 1945. Of the 1946 exports, 91,466 tons were classified as bauxite and other aluminum ores and 6,322 tons as bauxite concentrates (including alumina). Canada was the largest recipient of the exports; virtually all of the bauxite and other aluminum ores and 97 percent of the bauxite concentrates (including alumina) were shipped to that country in 1946. Most of the bauxite exported to Canada is used to manufacture crude abrasives, which are returned to the United States for final manufacture and consumption. Otherwise, the exports to Canada consisted almost entirely of activated bauxite destined for use in petroleum refineries.

Bauxite and aluminum compounds exported from the United States, 1942–46

Year	Bauxite (including bauxite concentrates), long tons			Aluminum sulfate		Other aluminum compounds	
	As exported	Dried bauxite equivalent	Value	Short tons	Value	Short tons	Value
1942	260,600	294,176	$5,086,695	44,428	$1,103,340	2,384	$354,397
1943	417,186	528,839	5,575,128	37,946	963,151	2,922	307,288
1944	146,638	210,852	2,928,799	41,434	1,072,140	3,802	528,821
1945	126,077	156,129	2,424,921	37,972	993,869	4,106	530,350
1946	97,788	127,840	1,599,259	37,957	962,938	4,055	637,997

WORLD REVIEW

Greatly increased outputs of bauxite in British Guiana, France, and Hungary were largely responsible for a slight gain in world production in 1946 over 1945. About 70 percent of the total world production is estimated to have been mined in the Western Hemisphere in the United States and the Guianas in 1946, compared with 64 percent in 1945.

Australia.—The Australian Aluminum Production Commission was investigating bauxite deposits in Australia to determine which will be used as raw material for the proposed alumina plant and reduction works (capacity, 12,000 long tons) to be erected in Tasmania. Commercial bauxite deposits are known to occur in New South Wales,

Queensland, Tasmania, Victoria, and Western Australia. Consumption of bauxite in Australia heretofore has been small and virtually all has been supplied by Victoria and New South Wales.

World production of bauxite, 1940–46, by countries, in metric tons

[Compiled by B. B. Mitchell]

Country	1940	1941	1942	1943	1944	1945	1946
Australia:							
New South Wales	2,081	2,671	1,832	734	2,025	1,700	(1)
Victoria	1,446	2,793	1,655	1,855	1,842	1,792	2,351
Austria		879	554	24	18,812	8,756	(1)
Brazil	82	14,365	29,890	[2] 76,761	[2] 2,979	[2] 7,060	[2] 1,161
British Guiana	634,510	1,060,979	1,215,744	1,919,060	928,178	678,482	[2]1,137,991
France	489,020	587,420	639,560	916,350	665,630	252,416	478,242
French West Africa	3,390	(1)	(1)	(1)	(1)	(1)	(1)
Germany	8,911	12,478	13,752	(1)	(1)	(1)	(1)
Gold Coast		14,886	44,767	162,685	107,854	148,547	116,846
Greece	75,000	18,000	23,000	25,000	10,000	(1)	(1)
Haiti						300	300
Hungary	561,710	823,410	988,550	1,001,370	758,299	35,402	100,760
India	8,154	13,170	18,551	24,548	12,330	14,116	(1)
Indochina, French	118	10,200	12,800		360	(1)	(1)
Italy	571,324	536,881	509,430	[3] 210,634	(1)	2,584	65,447
Jamaica				2,642			(1)
Japan					2,000		
Netherlands East Indies	275,345	171,821	(1)	(1)	(1)	(1)	(1)
Palau Island [4]	22,495	59,297	135,669	104,223	1,000		
Portuguese East Africa	1,030	1,352	1,860	3,272	6,177	4,369	(1)
Rumania	10,279	9,762	15,041	12,633	(1)	(1)	(1)
Spain		1,393	2,214	23,947	2,921	5,119	4,926
Surinam	615,434	1,198,900	1,227,512	1,655,147	625,804	[2] 683,990	570,639
Unfederated Malay States (Johore)	63,787	(1)	(1)	(1)	(1)	(1)	(1)
U. S. S. R. (estimate)	300,000	250,000	275,000	350,000	400,000	400,000	(1)
United Kingdom		13,090	95,724	107,924	44,502	36,981	(1)
United States (dried equivalent) [5]	446,253	952,082	2,643,775	6,332,868	2,869,021	996,754	1,090,044
Yugoslavia	[6] 245,195	[6] 203,000	[3 6] 86,000	(1)	(1)	(1)	(1)
Total	4,390,000	6,038,000	8,464,000	14,137,000	7,137,000	3,700,000	4,000,000

[1] Data not available. Estimate included in total. [2] Exports. [3] January–June.
[4] Imports into Japan and Formosa in fiscal year ended Mar. 31 of year following that stated; preliminary figures. [5] Mine production of crude ore.
[6] Croatia only; estimate for rest of Yugoslavia included in total.

Brazil.—Attempts to develop aluminum-ingot production in Brazil so far have been unsuccessful. The Eletro-Quimica Brasiliera, S. A., which, on March 29, 1945, began the production of primary aluminum at Ouro Preto, Minas Gerais, ceased operations in 1946 because of high capital charges and heavy transport costs on bauxite. The estimated output of aluminum during the period of operation was only 525 metric tons. Thus, the expected increase in production of bauxite as a result of the birth of Brazil's aluminum industry did not materalize. Exports of bauxite from Brazil were only 1,161 metric tons in 1946, compared with 7,060 tons in 1945.

British Guiana.—Bauxite production in British Guiana expanded stupendously following the outbreak of war in 1939; exports during the 7 years, 1939–45, were 6,803,958 long tons compared with 1,110,137 tons during the preceding 7 years. Record exports of 1,901,393 tons were made in 1943. The Demerara Bauxite Co., Ltd., controlled by the Aluminum Co. of Canada, was the major producer during the war and shipped virtually all its output to Arvida, Quebec, Canada, for the production of alumina. The Berbice Bauxite Co., the only other producer, which made its initial output in 1942, accounted for only 7 percent of the 1,116,463 tons exported in that

year. The company suspended operations in 1943, but they were resumed on a limited scale during the last quarter of 1945. Total exports from British Guiana were 1,120,015 long tons in 1946—the second highest on record—compared with 738,544 tons in 1945. Of the 1946 exports, 92 percent were destined to Canada, 6 percent to the United States, 1 percent to the United Kingdom, and the remainder to Argentina and Sweden.

France.—Production of bauxite in France increased to 478,242 metric tons in 1946 from 252,416 tons in 1945. Deliveries to local mills during 1946 exceeded those of prewar years, whereas exports, which averaged 24,000 tons monthly in 1938, were smaller.

Haiti.[3]—Work was continued in 1946 on the construction of an access road to the Ste. Croix bauxite concession of Reynolds Mining Corp;. 6 miles have been completed, and the remaining 4 miles were expected to be finished by late spring.

Hungary.—Hungaro-Russian Bauxite-Aluminium Corp., formed in May 1946 following negotiations between the Hungarian and Soviet Governments, has taken over all the chief Hungarian bauxite deposits and aluminum plants; scheduled production of bauxite was 400,000 metric tons for 1946, 500,000 for 1947, and 700,000 for 1948.[4] However, output was only 100,760 metric tons in 1946, compared with 35,402 and 758,299 tons, respectively, in 1945 and 1944.

Italy.—Rehabilitation of alumina plants in Italy resulted in a sharp rise in output of bauxite during the last 5 months of 1946, during which time 90 percent of the total (65,447 metric tons) was produced. Production was only 2,584 tons in 1945. As a result of the Italy-Yugoslavia border settlement, the bauxite production in Venezia Giulia, the source of about 80 percent of Italy's requirements before the war, has been lost; but it may be partly offset by the development of new sources in southern Italy, where the three principal mines are the San Giovanni Rotondo, Monte Nutria, and Il Cavone. Proved reserves of the three mines are estimated at about 3,000,000 metric tons. Numerous prospects are found near these mines and in the Lecce area.

The San Giovanni Rotondo mine, about 6 miles south of San Giovanni Rotondo, Province of Foggia, has been the chief producer. Prospecting for bauxite began in mid-1938, the main deposit was discovered in 1939, and outputs of 146,443, 128,000, and 170,772 metric tons, respectively, were made in 1940, 1941, and 1942. Ore reserves have been estimated by the producer at 2,000,000 tons and by the Italian Government at "not less than 10,000,000 tons." The commercial-grade ore is divided into two grades; the first grade, containing 54 to 55 percent Al_2O_3 and 3.5 percent SiO_2, comprises 30 percent of the total ore, and the second grade, containing 50 to 53 percent Al_2O_3 and 4 percent SiO_2, comprises 70 percent of the total.

Malaya[5].—Bauxite is probably of widespread occurrence in Malaya, but deposits have been worked only in Johore and Malacca. Several of the bauxite occurrences in Johore have resulted from the weathering of ancient volcanic rocks, but some appear to have been derived from shale. Production of bauxite in Malaya was begun in 1936, when the

[3] Bristol, H. H., Jr., American Embassy, Port-au-Prince, Haiti, Jan. 29, 1947.
[4] Chemical Age, vol. 55, No. 1416, Aug. 17, 1946, p. 205.
[5] Richardson, J. S., Jr. (American consul, Singapore), Bauxite in Malaya: Ms. Rept., July 16, 1947, 7 pp.

Ishihara Sangyo Koshi commenced mining a deposit at Bukit Pasir Mas near Batu Pahat. In 1937 the Perigi Achih mine was opened, and exports from Sri Medan mine started in 1938. These three mines, all in south Johore, were the only ones in operation up to 1941.

During Japanese occupation, the Malacca (Telok Mas) and Nangan mines were worked. The Malacca area was prospected by the Japanese in 1939, but no mining license was issued. The Japanese Military Administration ordered work to commence in May 1942. Most of the equipment was brought from the Sri Medan (Higashiyama) mine, but some machinery was also obtained from Japan. Work commenced in August 1943, and up to October 1944 about 100,000 tons of ore were shipped to Japan. Lack of transport prevented further shipments. It is estimated that about 200,000 tons of ore are still deposited in the Bukit Lintan section of the mine, and 70,000 tons of produced ore were stored on the property. The ore is stated to average 52 percent Al_2O_3, 4 percent SiO_2, 1 percent TiO_2, and 10 percent Fe_2O_3.

The Nangan mine is situated around Bukit Simon about 10 miles east of Kampong Pengerang, and the deposit of bauxite covers a large area. Bauxite was found in 1935 but no proprietary rights were issued. The area was estimated to contain about 10,000,000 tons of bauxite, and a development project envisaging a production of 500,000 tons annually was inaugurated. Nonarrival of machinery from Japan caused the plan to be discontinued, although equipment from the Kemaman iron mine, Trengganu, was transferred to the area. One shipment of 3,450 tons was made to Japan in July 1944, and about 42,000 tons of ore on the property remained unshipped. The average grade of the ore was 56 percent Al_2O_3, 4 percent SiO_2, 0.7–0.8 percent TiO_2, and 6–7 percent Fe_2O_3.

Netherlands East Indies.—The only producer of bauxite in Netherlands Indies is the N. V. Billiton Maatschappij, which owns mines on the island of Bintan. After the Netherlands Indies had been overrun by the Japanese in 1942, production of bauxite was resumed by the Japanese Furukawa Co., Ltd. According to reports found after the liberation of the Netherlands Indies, the invaders exported 1,385,827 tons of bauxite during the three years 1942–44. After the liberation, the drying kiln was found dismantled, the mining equipment removed or worn out, and the aerial ropeway for transporting the bauxite to the loading station in need of repair. Rehabilitation of the equipment has been in progress by the Billiton Co., which expected to resume production in the latter part of 1947.

Surinam.—Despite a short strike of workers at the mines and docks and the prolonged strikes of maritime workers in the United States and Trinidad, exports of bauxite from Surinam advanced for the second consecutive year and were 48 percent greater than production; they totaled 844,292 long tons in 1946 compared with 673,185 tons in 1945. The Surinaamsche Bauxiet Maatschappij, which operates mines at Paranam and Moengo, and the N. V. Billiton Maatschappij, which operates a mine at Onverdacht, accounted for the exports in both years. Early in 1947 calcining equipment was installed at the Paranam plant of the Surinaamsche Bauxiet Maatschappij.

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In Minerals Yearbook, 1945, it was erroneously stated that the bauxite deposits of the N. V. Billiton Maatschappij were too small to warrant construction of processing plants and that the company might cease operations in the near future. According to a letter to the author from the N. V. Billiton Maatschappij:

> After continuously producing bauxite in three shifts during the war years, production was temporarily stopped in Surinam from the middle of April 1945 until the middle of July 1945 for complete overhaul of the plant. Thereafter production has been regularly continued in two shifts at the rate of approximately 20,000 tons of bauxite monthly. Recently same has been stepped up to about 25,000 tons. At present a calcining kiln is being erected at the mine and production is being expected to start within the near future at an initial yearly capacity of approximately 30,000 tons of calcined bauxite. Ore reserves in Surinam are estimated at over 30 years at present rate of production. The mine is situated at Onverdacht * * * and has its own boatloading station at Smalkalden on the Para River (loading capacity about 500 tons per hour). A complete ore processing plant and a drying kiln are situated near the boatloading station. The open-pit production is highly mechanized by means of diesel draglines and bulldozers. Transportation of the ore from the mine to the plant and boatloading station takes place by means of a railroad. Modern living quarters, recreation facilities, and free medical service have been established by Billiton at Onverdacht for its employees.

The interest of two new American companies in bauxite deposits in Surinam may presage an expansion in production. The Reynolds Metals Co. has had engineers in Surinam to search for bauxite deposits, but no action had been taken by the Government on its application for a concession. The Permanente Metals Corp. (Kaiser Co., Inc., subsidiary) has likewise had engineers investigating deposits on an option along the Marowijne River near the French Guiana border.

Bismuth

By RICHARD H. MOTE

GENERAL SUMMARY

DOMESTIC refinery production of metallic bismuth declined sharply in 1946 compared with 1945, but was partly offset by a 27-percent increase in imports, a 19-percent drop in consumption, and a net reduction of 176,283 pounds of metallic bismuth in Government stocks. The prices of bismuth metal and salts increased following removal of ceiling prices in July 1946.

DOMESTIC PRODUCTION

Refined metallic bismuth produced in the United States is recovered entirely as a byproduct in the smelting of domestic and foreign lead and copper ores, whose primary value in bismuth is negligible, and in the refining of Mexican bismuth-lead bullion. Prolonged labor strikes at domestic lead smelters and refineries during the first half of 1946 sharply curtailed the output of refined lead; this in turn cut the bismuth recoveries, resulting in a 38-percent drop in the production of refined bismuth in 1946 as compared with 1945. The Bureau of Mines is not at liberty to publish statistics showing the domestic production of bismuth. Domestic producers (smelters and refineries) in 1946 continued to be the American Smelting & Refining Co., Anaconda Copper Mining Co., and the United States Smelting, Refining, & Mining Co. The world's largest producer of bismuth, and the principal domestic importer and consumer, is the Cerro de Pasco Copper Corp., New York, which refines large quantities of bismuth in Peru.

CONSUMPTION AND USES

Domestic bismuth consumption was approximately 1,330,000 pounds in 1946, a decline of 19 percent from 1945 and 47 percent from the apparent consumption of 2,500,000 pounds in the peak year 1942.

The manufacture of bismuth pharmaceuticals—which comprise principally antisyphilitic drugs, antiacid or stomach remedies, and cosmetic powders—consumed about 831,900 pounds (63 percent) of bismuth in 1946, approximately the average quantity consumed for that purpose during the last decade.

Metallurgical uses represented 37 percent of the bismuth consumption in 1946 compared with 49 percent in 1945, 55 percent in 1942–44, and about 25 percent in the middle 1930's. Bismuth is used with cadmium, tin, and lead in the manufacture of low-melting alloys for fire alarms, sprinklers, and other fire-fighting apparatus. Similar alloys are employed in bending thin-walled tubing and in making patterns,

particularly in the aircraft industry. Other bismuth alloys are used as solders, coatings for selenium rectifiers, and safety fuses in electrical circuits and compressed-gas cylinders.

Bismuth consumed in the United States, 1944–46, by uses

[Figures compiled by Civilian Production Administration]

Use	1944		1945		1946	
	Pounds	Percent of total	Pounds	Percent of total	Pounds	Percent of total
Pharmaceuticals	585,193	40	839,458	51	831,882	63
Fabricating alloys	426,894	29	371,334	23	306,891	23
Ammunition solders	211,789	14	91,250	6	68,860	5
Fuse alloys	91,096	6	77,169	5	38,900	3
Aluminum alloys	8,315	1	58,107	3	33,514	2
Other [1]	142,353	10	197,975	12	50,221	4
Total consumption	1,465,640	100	1,635,293	100	1,330,268	100

[1] Principally rectifier coating, nucleonics, and commercial solders.

STOCKS

Stocks of bismuth metal held by producers, distributors, and consumers declined 21 percent in 1946. Bismuth-metal inventories of Government-owned Office of Metals Reserve gradually diminished from 762,829 pounds on January 1, 1946, to 586,546 pounds on December 31, a decline of 23 percent. The Government held no stocks of bismuth ore or concentrates during 1946.

PRICES

On July 8, 1946, the New York quoted price for bismuth metal increased from the maximum ceiling price of $1.25 a pound, ton lots—at which level it had been since October 1939—to $1.60 a pound. A further advance in price to $1.80 a pound became effective December 2.

The London price of bismuth ore, 50 percent, c. i. f., per pound of contained Bi, was quoted at 3s. 0d. until April when the price advanced to 4s. 0d. at which level it remained for the rest of the year. Metallic bismuth, 99.95 percent, 5-cwt. lots, which sold for 6s. 8d. through March, advanced to 9s. in April and again to 10s. in December. The price per pound of bismuth matrix and bending alloys was raised from 4s. 6d. and 5s., respectively, in January to 4s. 9d. and 5s. 5d. in February. Matrix alloy was further advanced to 6s. 1d. in April.

FOREIGN TRADE [1]

Imports.—Of the 422,336 pounds of refined metallic bismuth imported in 1946, 392,306 pounds came from Peru and 30,030 pounds from Canada. All entries of refined metallic bismuth in 1941–45 were from Peru. Almost the entire Mexican bismuth output (see world production table) is imported in the form of bismuth-lead bars for refining in the United States.

[1] Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Bismuth imported for consumption in the United States, 1942–46

Year	Bismuth ore[1]			Refined metallic bismuth		Bismuth compounds and mixtures	
	Pounds		Value	Pounds	Value	Pounds	Value
	Gross weight	Bi content					
1942	(1)	(1)	(1)	(2)	(2)	7	$22
1943	138,600	48,800	$52,400	[3] 430,874	[3] $442,301	13	53
1944	118,739	51,349	60,878	363,980	345,796	40	352
1945				333,231	316,135		
1946	(1)	(1)	(1)	422,336	464,922		

[1] Figures from Foreign Economic Administration. Those for 1942 and 1946 not available.
[2] No "imports for consumption"; general imports of 222,684 pounds were reexported.
[3] An additional 71,236 pounds (valued at $43,498) reported by the U. S. Department of Commerce as "bismuth" is ore and is covered by that category in this table.

Exports.—Exports of bismuth metal and alloys in 1946, principally to United Kingdom, France, and Italy, increased 32 percent over 1945.

Bismuth exported from the United States, 1944–46, by classes

Class	1944		1945		1946	
	Pounds	Value	Pounds	Value	Pounds	Value
Matte	46	$74			93,960	$8,629
Metal and alloys	10,161	8,557	115,543	$149,031	153,058	173,463
Compounds and mixtures:						
Carbonate	46,761	67,725	22,197	35,178	(1)	(1)
Chloride	501	1,473	(2)	(2)	(1)	(1)
Gallate	8,429	13,302	(3)	(3)	(1)	(1)
Iodide	2,884	1,432	(3)	(3)	(1)	(1)
Nitrate	42,845	56,319	78,895	105,061	(1)	(1)
Oxide	355	1,154	(2)	(2)	(1)	(1)
Sulfate	2	20	(2)	(2)	(1)	(1)
Other	11,299	26,482	[2] 22,331	[2] 50,902	(1)	(1)

[1] Beginning Jan. 1, 1946, data not separately classified.
[2] Data for chloride, oxide, and sulfate included with "other."
[3] Data not available.

WORLD REVIEW

World production of bismuth approximated 940,000 kilograms (2,072,000 pounds) in 1946. The principal producers were United States, Peru, Canada, and Mexico.

World production of bismuth, 1940–46, by countries, in kilograms [1]

[Compiled by B. B. Mitchell]

Country [1]	1940	1941	1942	1943	1944	1945	1946
Argentina: Metal	4,880	10,040	13,101	18,000	(2)	[3] 24,000	(2)
In ore [3]	3,000	5,000	17,000	25,000	(2)	(2)	(2)
Australia (in ore) [4]	2,800	2,200	4,800	6,800	7,800	(2)	(2)
Bolivia (in ore and bullion exported) [5]	18,700	22,604	8,896	12,419	605	15,337	27,867
Canada: Metal	18,479	6	156,605	184,882	56,188	86,098	106,140
In bullion	8,069	3,401	1,043				
China (in ore) [3]	16,000	33,000	11,000	(2)	(2)		1,380
France (metal)	7,000	11,000	10,000	5,000	3,000	(2)	(2)
Germany: In bismuth ore	18,300	14,600	17,500	(2)	(2)	(2)	(2)
In other ores	4,800	7,700	14,700	(2)	(2)	(2)	(2)
Japan (metal) [6]	51,000	68,000	71,000	66,000	54,000	(2)	(2)
Mexico (in impure bars)	185,433	97,971	128,041	175,055	165,379	161,368	76,000
Peru: Metal	387,479	276,907	373,942	482,920	416,159	307,446	221,778
In lead-bismuth alloy	56,314	178,138	16,913			1,500	89,771
Spain (metal)	10,878	3,900	15,880	15,198	4,910	10,071	(2)
Union of South Africa (in ore)	(2)	332	167	1,815	818		554
United States	(7)	(7)	(7)	(7)	(7)	(7)	(7)
World production (estimate)	1,400,000	1,400,000	1,700,000	1,400,000	1,200,000	1,100,000	940,000

[1] Bismuth is believed to be produced also in Brazil, Burma, Chile, Norway, Rumania, Sweden, Uganda, U. S. S. R., United Kingdom, and Yugoslavia. Production figures are not available for these countries, but estimates by author are included in total.
[2] Data not available. Estimate by author included in total.
[3] Estimate.
[4] Partly estimated. Excludes content of some bismuth-tungsten concentrates.
[5] Excludes bismuth content of tin concentrates exported.
[6] Incomplete preliminary data for year ended Mar. 31 of year following that stated.
[7] Production included in total; Bureau of Mines not at liberty to publish separately.

Bolivia.—The principal producers of bismuth ore in 1946 continued to be the Compagnie Aramayo de Mines en Bolivia and Fabulosa Consolidated.

Canada.—In 1946 the total Canadian production was derived from treatment of lead-silver ores by the Consolidated Mining & Smelting Co., Ltd., at Trail, B. C.

China.—Bismuth production in China is entirely a byproduct of tungsten mining. Bismuthinite is the chief ore mineral, but native bismuth and bismuth ocher also occur.

Peru.—According to official figures, bismuth exports from Peru since 1938, in metric tons, were as follows:

Year	1938	1939	1940	1941	1942	1943	1944	1945	1946
Exports	219	438	383	520	346	484	446	272	[1] 400

[1] Estimated.

Spain.—The Valle de las Perdoches mine in Cordoba Province produced 47 metric tons of bismuth concentrates in 1945 compared with 48 tons in 1944.

United Kingdom.—Imports of bismuth metal were 486,708 pounds in 1946 compared with 381,878 pounds in 1945.

Cadmium

By RICHARD H. MOTE

GENERAL SUMMARY

CADMIUM supplies continued inadequate to meet total consumer demands in 1946. Domestic output of cadmium, like that of all the nonferrous byproduct metals, was restricted during the year by labor strikes and manpower shortages; as a result, primary cadmium production declined 23 percent to the lowest level since 1940. During 1946 inventories were drawn upon to supplement the declining output, with the result that stocks dropped 35 percent. The apparent consumption of cadmium in all forms also dropped from the 1945 level owing to the reduction in supply.

Government control of cadmium use was reinstated early in 1946, accompanied by tightened inventory restrictions. Government regulation continued until the removal of cadmium from price control on July 26.

Prices advanced twice in 1946—from 90 cents a pound for commercial sticks and 95 cents for patented shapes at the beginning of the year to $1.50 and $1.55, respectively, at the year end.

Salient statistics of the cadmium industry in the United States, 1942–46, in pounds of contained cadmium

	1942	1943	1944	1945	1946
Production (primary)	7,370,969	8,466,963	8,779,856	8,383,629	6,471,187
Imports (metal)	53,298	48,891	66,627	28,724	17,415
Exports (metal)	251,059	156,844	548,015	102,199	140,385
Consumption	7,659,000	7,381,000	8,865,000	[1] 8,642,799	[1] 6,954,957

[1] Apparent consumption.

GOVERNMENT REGULATIONS

Cadmium continued under Government control during part of 1946. At the beginning of the year control was limited to consumers' inventories of cadmium, which were restricted to 45 days' requirements or a minimum working inventory, whichever was smaller. As a result of expanding consumer demand, limited supply, and a sharp reduction of Government stocks, the Civilian Production Administration on February 1 reinstated control on the consumption of cadmium through provisions of Conservation Order M–389 (wartime control of cadmium consumption had been relinquished August 20, 1945, when General Preference Order M–65 was revoked). Order M–389 limited the manufacturers' use of cadmium metal to 90 percent of their consumption in 1941. The limitation on inventories was reduced on February 1 to 30 days' supply by an amendment to table 1 of Priorities Regulation 32. A continued shortage of cadmium necessitated the establishment of a list of essential consumers, and on March 22 the CPA revoked Order M–389 and simultaneously established a specific list of products on which ratings were to be issued for procurement of the metal. Facing a sharp reduction in output of metal because of strikes at zinc smelters producing byproduct cadmium, the CPA on May 3 ceased to make further allocations from the Government stock pile, except for emergency use. No additional regulations were issued until July 26, when all Government controls

on cadmium were terminated with the removal of cadmium from price control.

TARIFF

In accordance with the Canadian Trade Agreement of 1939, the tariff on cadmium metal remained at 7½ cents per pound. Cadmium contained in flue dust remained duty free.

DOMESTIC PRODUCTION

The entire supply of domestic primary cadmium is recovered concurrently with the treatment of ores of other metals—notably those of zinc and lead—both imported and mined in the United States. As no mines are operated solely for the cadmium content of their ores and as many reduction plants participating in the recovery of cadmium treat both domestic and foreign materials without determining the cadmium content of either, the origin of the metal produced at United States plants is a matter of conjecture. Thus the data presented as domestic cadmium production in this chapter are not comparable to those given in other chapters for metals like copper, lead, and zinc. Most of the metal is extracted from Cottrell and baghouse dusts, the next important source being the sludges precipitated from zinc solu-

Cadmium produced and shipped in the United States, 1942–46, in pounds of contained cadmium

	1942	1943	1944	1945	1946
Production:					
Primary:					
Metallic cadmium	7,323,346	8,396,292	8,453,470	7,932,579	6,200,398
Cadmium compounds [1]	47,623	70,671	326,386	451,050	270,789
Total primary production	7,370,969	8,466,963	8,779,856	8,383,629	6,471,187
Secondary (metal and compounds) [1 2]	316,345	162,424	106,850	72,473	355,104
Shipments by producers:					
Primary:					
Metallic cadmium	7,233,043	8,326,768	8,551,424	7,938,658	6,180,265
Cadmium compounds [1]	78,059	137,952	285,203	451,050	270,789
Total primary shipments	7,311,102	8,464,720	8,836,627	8,389,708	6,451,054
Secondary (metal and compounds) [1 2]	304,894	187,913	106,850	67,513	360,924
Value of primary shipments:					
Metallic cadmium	$5,740,082	$6,570,546	$6,435,124	$6,106,992	$6,094,572
Cadmium compounds [3]	61,948	108,844	213,902	347,308	267,033
Total value	5,802,030	6,679,390	6,649,026	6,454,300	6,361,605

[1] Excludes compounds made from metal.
[2] Bureau of Mines not at liberty to publish figures separately for secondary cadmium compounds.
[3] Value of metal contained in compounds made directly from flue dust or other cadmium raw materials (except metal).

tion preliminary to the electrolytic recovery of zinc. Secondary metal is recovered from old bearings and other alloys but constitutes no great part of the total cadmium supply.

The domestic output of primary metallic cadmium declined 23 percent in 1946 to the lowest level since 1940. The output of cadmium contained in primary compounds also dropped, but the recovery of secondary metal increased. Labor strikes and manpower shortages at zinc-reduction plants were largely responsible for the drop in primary cadmium output.

A list of plants producing cadmium metal in the United States in 1946 follows:

Primary metallic cadmium

Colorado: Denver—American Smelting & Refining Co.
Idaho:
Bradley—Bunker Hill & Sullivan Mining & Concentrating Co.
Kellogg—Sullivan Mining Co.
Illinois: Fairmont City—American Zinc Co. of Illinois.
Missouri: Herculaneum—St. Joseph Lead Co.
Montana: Great Falls—Anaconda Copper Mining Co.
Oklahoma:
Bartlesville—National Zinc Co., Inc.
Henryetta—Eagle-Picher Mining & Smelting Co.
Pennsylvania:
Donora—American Steel & Wire Co.
Josephtown—St. Joseph Lead Co.
Palmerton—New Jersey Zinc Co.
Texas: Corpus Christi—American Smelting & Refining Co.

Secondary metallic cadmium

Arkansas: Jonesboro—Arkansas Metals Co.
Michigan: Detroit—Aetna Smelting & Refining Co.
New York: Whitestone—Neo-Smelting & Refining, Inc.

The total output of cadmium oxide and sulfide increased 51 percent in 1946 to 1,543,447 pounds of contained cadmium. Data for the production of other cadmium compounds are not available for 1946.

Cadmium oxide and cadmium sulfide produced in the United States, 1942–46, in pounds

Year	Oxide		Sulfide [1]		Year	Oxide		Sulfide [1]	
	Gross weight	Cd content	Gross weight	Cd content		Gross weight	Cd content	Gross weight	Cd content
1942	632,739	553,467	1,001,124	300,414	1945	439,415	383,553	1,731,510	637,667
1943	537,357	469,976	671,831	227,045	1946	364,285	317,767	3,637,177	1,225,680
1944	571,366	499,507	1,312,263	466,794					

[1] Includes cadmium lithopone and cadmium sulfoselenide.

CONSUMPTION AND USES

The apparent consumption of cadmium in all forms in the United States dropped 20 percent in 1946 but remained well above the prewar level. The principal use of cadmium metal is as a protective coating for steel and, to a much smaller extent, for copper alloys. Consumption for this purpose is estimated at approximately 4,000,000 pounds in 1946. The manufacture of bearing alloys is also a large use of cadmium metal. Cadmium-base bearings are generally of two types, the cadmium-nickel bearing composed of 98.65 percent cadmium and 1.35 percent nickel and the cadmium-silver bearing containing 0.2–2.25 percent silver and 0.25–2 percent copper in place of the nickel. Such bearings are used principally in automotive engines for service under high pressures and at high speeds.

Another use of cadmium metal, although not involving any great tonnage, is in the manufacture of low-melting-point alloys for special solders and fusible alloys for sprinkler apparatus, fire-detector systems, and valve seats for high-pressure gas containers.

Cadmium is also consumed in the production of cadmium compounds, the most important of which are cadmium sulfide and cad-

mium oxide. Cadmium sulfide and sulfoselenide are standard agents for producing yellow and red colors, respectively, in paints, ceramics, inks, rubber, and leather. Cadmium oxide, hydrate, and chloride are used in electroplating solutions; and cadmium bromide, chloride, and iodide are used in the preparation of special photographic films.

Apparent consumption of cadmium in the United States, 1945–46, in pounds

	1945	1946		1945	1946
Supply:			Withdrawn:		
Total stocks Jan. 1 [1]	2,056,457	1,723,812	Exports (metal)	102,199	140,385
Production (primary)	8,383,629	6,471,187	Total stocks Dec. 31 [1]	1,723,812	1,117,072
Imports (metal)	28,724	17,415			
			Total withdrawn	1,826,011	1,257,457
Total supply	10,468,810	8,212,414	Apparent consumption	8,642,799	6,954,957

[1] Excludes consumers' stocks, which were about 1,000,000 pounds at the end of 1944.

STOCKS

Total domestic stocks of cadmium metal and compounds, excluding consumers' stocks for which data are not available, decreased 35 percent in 1946. Details are given in the accompanying table.

Cadmium stocks at end of year, 1945–46, in pounds of contained cadmium

	1945 [1]			1946		
	Metallic cadmium	Cadmium compounds	Total cadmium	Metallic cadmium	Cadmium compounds	Total cadmium
Producers	245,769		245,769	260,081		260,081
Compound manufacturers	12,415	122,529	134,944	31,710	84,725	116,435
Distributors [2]	390,487	45,187	435,674	134,085	25,511	159,596
Government	907,425		907,425	580,960		580,960
Total stocks [3]	1,556,096	167,716	1,723,812	1,006,836	110,236	1,117,072

[1] Figures partly revised.
[2] Comprises principally 6 largest dealers.
[3] Excludes consumers' stocks, which were about 1,000,000 pounds at the end of 1944.

PRICES

The quoted price for cadmium remained at 90 cents a pound for commercial sticks and 95 cents a pound for patented shapes until Government control of prices was relinquished in midyear, after which the price increased to $1.25 and $1.30, respectively, on July 8 and again to $1.50 and $1.55, respectively, on December 2. The average price of domestic metal, as reported to the Bureau of Mines by primary producers, was 99 cents a pound in 1946, compared with 77 cents in 1945, 75 cents in 1944, 79 cents in 1943 and 1942, and 78 cents in 1941.

FOREIGN TRADE [1]

In 1946 total imports for consumption of metallic cadmium and of cadmium contained in flue dust decreased 25 percent in weight and 37 percent in value. Exports of cadmium decreased 32 percent in value.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Imports.—Imports of flue dust were substantially below the 1945 rate; Mexico continued to be the main source of dust, but a small quantity was received from the Netherlands. Metallic cadmium imports from Belgian Congo declined 74 percent in 1946. A sharp increase in imports from Canada and Peru and a reappearence of imports from Belgium—the first since 1940—were somewhat compensatory, however. Although the accompanying table of imports shows only metal and dust, a very considerable additional quantity of cadmium enters the United States in zinc ores and concentrates produced in several foreign countries, including Mexico, Canada, Peru, and Bolivia. Much of this cadmium is recovered in the reduction of these imported materials.

Cadmium metal and flue dust imported for consumption in the United States, 1944–46, by countries

Country	1944		1945		1946	
	Pounds	Value	Pounds	Value	Pounds	Value
Metallic cadmium						
Belgian Congo	53,082	$50,699	25,798	$22,997	6,700	$5,444
Belgium and Luxembourg					2,240	5,366
Canada			672	793	3,568	5,459
Italy	8,656	7,790				
Peru	4,889	4,495	2,254	2,029	4,907	7,629
	66,627	62,984	28,724	25,819	17,415	23,898
Flue dust (Cd content)						
Mexico	1,689,322	835,615	2,192,685	992,286	1,609,366	598,494
Netherlands					43,539	19,397
	1,689,322	835,615	2,192,685	992,286	1,652,905	617,891
	1,755,949	898,599	2,221,409	1,018,105	1,670,320	641,789

Exports.—The total value of cadmium exported in 1946 was almost one-third less than that of the previous year due to a 77-percent drop in the value of cadmium exported in drosses, flue dusts, residues, and scrap. The value of cadmium-metal exports increased 63 percent over 1945.

Cadmium exported from the United States, 1944–46, gross weight, by kinds

Kind	1944		1945		1946	
	Pounds	Value	Pounds	Value	Pounds	Value
Dross, flue dust, residues, and scrap	2,686,360	$217,640	2,333,720	$197,927	459,775	$45,587
Metal	548,015	515,447	102,199	100,493	140,385	163,879
Alloys	450	427	3	8	75	99
Salts and compounds	23,488	25,107	10,895	10,781	(1)	(1)
		758,621		309,209		209,565

[1] Beginning January 1, 1946, not separately classified.

WORLD REVIEW

World production of cadmium in recent years, insofar as data are available, is shown in the accompanying table.

World production of cadmium, 1938–46, by countries, in kilograms

[Compiled by B. B. Mitchell]

Country	1938	1939	1940	1941	1942	1943	1944	1945	1946
Australia (Tasmania)	199,326	175,150	175,232	194,975	165,821	160,100	253,972	223,784	224,128
Belgian Congo				3,086	27,344	23,094	21,544	18,223	16,571
Belgium	182,000	[1] 530,800	[2]	[2]	[2]	[2]	[2]	[2]	88,900
Canada	317,122	426,234	411,917	567,573	521,158	356,804	239,032	293,048	345,363
France	120,000	130,000	100,000	20,000	10,000	10,000	5,250	7,000	47,000
Germany	432,000	[3] 460,000	[3] 531,000	[3] 608,000	[3] 487,000	[2]	[2]	[2]	[2]
Italy	181,530	146,417	214,871	184,016	[2]	95,300	38,800	13,700	25,000
Japan	[4] 63,000	[4] 80,000	[2]	[2]	[4] 102,000	[4] 112,000	[4] 85,000	[5] 22,000	[6] 900
Mexico [7]	762,398	816,584	815,734	906,577	854,264	801,992	682,295	1,052,766	717,000
Norway	207,667	138,000	28,600	25,048	13,482	11,355	10,600	13,000	28,000
Peru					2,131	3,653	2,174	9,320	1,388
Poland	182,591	[2]	[2]	[2]	[2]	[2]	[2]	49,150	116,000
South-West Africa [7]	259,133	82,155	39,634	225,450	[2]	[2]	[2]		
U. S. S. R.	[8] 50,000	[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]
United Kingdom	124,898	[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]
United States:									
Metallic cadmium	1,849,722	2,001,026	2,791,484	3,146,976	3,321,797	3,808,474	3,834,409	3,598,139	2,812,457
Cadmium compounds (Cd content)	98,200	171,900	95,000	134,000	21,600	32,100	148,045	204,592	122,828
	4,008,000	4,584,000	4,853,000	5,264,000	5,030,000	5,263,000	5,164,000	4,633,000	4,049,000

[1] Exports.
[2] Data not available; estimate included in total.
[3] Beginning in October 1939, including Upper Silesia.
[4] Preliminary data for fiscal year ended March 31 of year following that stated.
[5] April to September, inclusive.
[6] November to December, inclusive.
[7] Cadmium content of flue dust exported for treatment elsewhere; represents in part shipments from stocks on hand. To avoid duplication of figures, data are not included in the total.
[8] Estimated figure.

Australia (Tasmania).—The Electrolytic Zinc Co. of Australasia, Ltd., operating mines and a milling plant at Rosebery, on the west coast, and a smelter at Risdon, near Hobart, Tasmania, produced 226 long tons of cadmium metal in the fiscal year ending June 30, 1946 from zinc concentrates, calcines, and flue dusts. About one-third of the material treated comes from company operations on the island of Tasmania and the remainder from the three largest mines in the Broken Hill district of New South Wales on the Australian mainland.

Canada.—Canadian output of refined metallic cadmium is derived from the zinc and lead ores of British Columbia and the zinc-copper ores of Saskatchewan and Manitoba. The Consolidated Mining & Smelting Co. of Canada, Ltd., at Tadanac (Trail), British Columbia, and the Hudson Bay Mining & Smelting Co., Ltd., at Flin Flon, Manitoba, produced about 79 and 21 percent, respectively, of the total Canadian output. A considerable quantity of cadmium of Canadian origin also is extracted at plants in the United States from imported zinc ores and concentrates.

Mexico.—Exports of cadmium contained in flue dusts recovered from ores of Mexican origin declined 32 percent in 1946. This material is recovered at the reduction works of the American Smelting & Refining Co. and the American Metal Co., Ltd., and all of it is exported for treatment—mostly to the United States. In addition to the cadmium contained in flue dust, an undeclared quantity of the metal is exported in zinc ores and concentrates. It is probable that, on a mine-output basis, Mexico is second only to the United States as a producer of cadmium.

Carbon Black

By F. S. LOTT AND H. BACKUS

GENERAL SUMMARY

FURTHER expansion in demand for carbon black raised production and sales to new heights in 1946. Production of 1,244,421,000 pounds was 18 percent above 1945 but was surpassed by sales that increased 24 percent to 1,269,740,000 pounds. The demand for contact blacks exceeded the supply, and producers' stocks were progressively depleted to minimum working levels at the end of the year. The decline in total stocks during 1946 from 102,005,000 pounds to 76,228,000 resulted from the drop of 47,950,000 pounds in the pro-

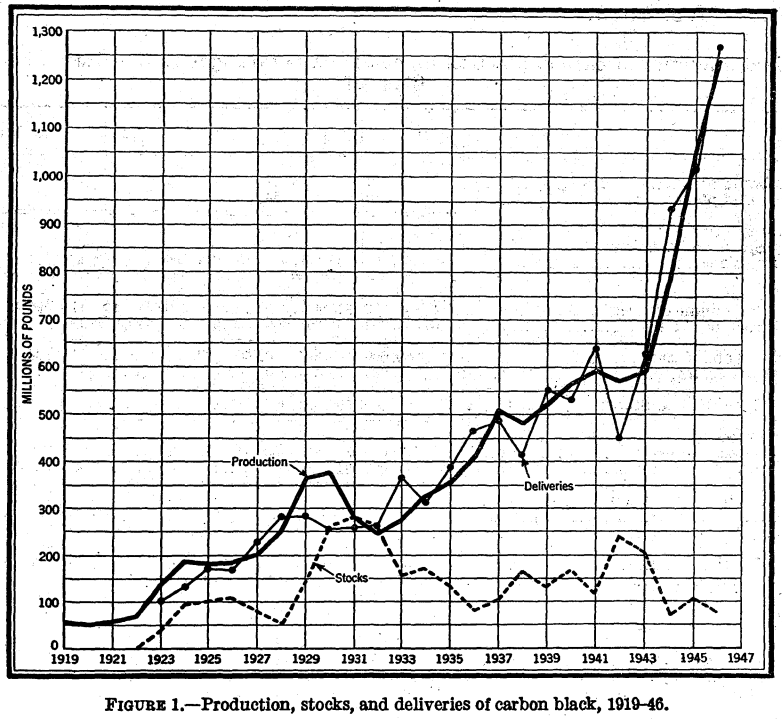

FIGURE 1.—Production, stocks, and deliveries of carbon black, 1919–46.

ducers' inventory of contact blacks and the addition of 22,173,000 pounds to stocks of furnace types.

Continuing the rapid growth that characterized the war period, the output of furnace (including thermal) blacks increased 22 percent over 1945 to 625,312,000 pounds and exceeded for the first time that of contact-type blacks—619,109,000 pounds. There is much evidence that the rise of the furnace group to the leading position in production volume foreshadows future dominance of the industry. However,

demand for channel black in early 1947, at prices above those commanded by the principal furnace grades, promises to tax the available facilities for production for several months at least.

Sales to rubber companies increased 17 percent over 1945 to a new record of 941,464,000 pounds, amounting to 94 percent of all domestic sales, compared with 95 percent in 1945. As an indication of the effect of synthetic rubber and new techniques upon the market for carbon black, it is interesting to note that the increase in sales to rubber companies in 1946 over 1941 was about 3.5 times the proportional increase in consumption of virgin rubber in the United States. More specifically, carbon-black sales for rubber in 1946 were 114 percent greater than in 1941, and rubber consumption (natural and synthetic) was only 33 percent greater.

Sales to ink and paint manufacturers increased to new records of 29,561,000 and 9,312,000 pounds, respectively, and miscellaneous trades absorbed 18,318,000 pounds of carbon black, a gain of 57 percent over 1945.

Salient statistics of carbon black produced from natural gas in the United States, 1942–46

	1942	1943	1944	1945	1946
Number of producers reporting	21	21	22	21	22
Number of plants	50	54	54	59	60
Quantity produced:					
By States and districts:					
Louisiana—pounds	90,353,000	109,609,000	160,019,000	168,229,000	191,857,000
Texas:					
Panhandle district—do	380,536,000	345,447,000	401,556,000	541,464,000	596,678,000
Rest of State—do	54,353,000	61,898,000	99,606,000	179,974,000	234,172,000
Total Texas—do	434,889,000	407,345,000	501,162,000	721,438,000	830,850,000
Other States—do	48,764,000	76,467,000	140,679,000	163,131,000	221,714,000
Total United States—do	574,006,000	593,421,000	801,860,000	1,052,798,000	1,244,421,000
By processes:					
Contact processes [1]—do	428,665,000	379,923,000	414,676,000	538,539,000	619,109,000
Furnace processes—do	145,341,000	213,498,000	387,184,000	514,259,000	625,312,000
Stocks held by producers Dec. 31:					
Contact types—pounds	[2]	196,913,000	58,036,000	64,956,000	17,006,000
Furnace types—do	[2]	8,302,000	11,207,000	37,049,000	59,222,000
Total—do	242,755,000	205,215,000	69,243,000	102,005,000	76,228,000
Losses—do	167,000	1,661,000	402,000	1,000	458,000
Quantity sold:					
Domestic deliveries—					
To rubber companies—do	295,947,000	473,473,000	738,029,000	804,386,000	941,464,000
To ink companies—do	19,233,000	23,530,000	24,479,000	22,824,000	29,561,000
To paint companies—do	3,616,000	3,945,000	5,315,000	7,421,000	9,312,000
For miscellaneous purposes—do	15,500,000	23,440,000	12,616,000	11,631,000	18,318,000
Total domestic deliveries—do	334,296,000	524,388,000	780,439,000	846,262,000	998,655,000
Export—do	115,635,000	104,912,000	156,991,000	173,773,000	271,085,000
Total sold—do	449,931,000	629,300,000	937,430,000	1,020,035,000	1,269,740,000
Value (at plants) of carbon black produced:					
Total	$19,547,000	$20,248,000	$29,411,000	$42,323,000	$59,988,000
Average per pound—cents	3.41	3.41	3.67	4.02	4.82
Estimated quantity of natural gas used—M cubic feet	335,533,000	315,562,000	355,770,000	431,830,000	478,349,000
Average yield of carbon black per M cubic feet—pounds	1.71	1.88	2.20	2.32	2.44
Average value of natural gas used per M cubic feet—cents	1.29	1.47	1.62	2.28	3.02

[1] Principally channel.

[2] Figure not available.

Insistent demand from foreign countries caused exports to rise to a new high of 271,085,000 pounds, in spite of export controls upon shipments of channel blacks. Prior to 1946, the largest total export was 203,828,000 pounds in 1939.

CURRENT TRENDS AND PROSPECTS

Several factors that will have an important bearing on the future of carbon black have become less obscure in the past 2 years. In the matter of costs of the dominant raw material—natural gas—a strong upward trend is evident, particularly with respect to channel plants for which supplies have been relatively cheap. This trend acts cumulatively to the detriment of channel-type production relative to that of the furnace type.

For example, assuming a yield of 1.5 pounds of carbon black per thousand cubic feet of gas burned for a channel plant and a gas cost of 3.0 cents per thousand cubic feet, the cost of gas alone per pound of product would be 2.0 cents. With the same gas cost and a yield of 8 pounds per thousand cubic feet for a furnace-type plant, the cost of gas per pound of product would be 0.375 cent, or 1.625 cents below that for the channel plant. If the cost of gas is raised to 5.0 cents per thousand cubic feet at both plants, other conditions remaining the same, the advantage of the furnace plant becomes 2.708 cents in gas cost per pound of product.

Reflecting urgent demand and cost factors, the average price of standard channel black has advanced since 1944 from a position below the prices of important grades of furnace blacks to a premium of one or more cents a pound above them. The probability of higher costs for channel black in the future indicates that the maintenance of large sales volume will depend upon quality factors. Suggestive of increasing competition from furnace blacks are recent announcements by two large producing companies of the development of new grades that are regarded as equal or superior to channel black for important applications. The opinion has been expressed that improved furnace blacks will gradually replace channel types in rubber processing.

World crude-rubber consumption in 1946 has been estimated by the London Rubber Secretariat at 1,455,000 tons, including 540,000 tons of natural. Of these totals, 1,039,000 tons, including 278,000 tons of natural rubber, were consumed in the United States. These figures indicate that over 60 percent of the foreign and about 27 percent of the United States consumption was natural rubber. A moderate increase in world rubber consumption has been forecast for 1947.

The use of natural rubber in the United States increased almost threefold in 1946 over 1945, and in foreign countries a sharp gain was also indicated. The return of natural rubber to world commerce has stimulated greatly the demand for channel blacks, although current practice in this country is to use materially less channel black than formerly per automotive tire manufactured. However, total loading with black per pound of rubber is now definitely higher than was the prewar custom. This factor will sustain the demand for carbon blacks at a higher ratio to rubber consumption than in former peacetime years, whether used in natural, synthetic, or blends of the two types of rubber.

In the early months of 1947, record sales of carbon black accompanied extremely active operations in the rubber-processing industry which reported a rate of output of automotive tire casings exceeding 100 million per year. Rubber trade expectations of reduced production schedules in the second half of 1947 suggest the current formation of a peak in domestic demand for carbon black. Export shipments have averaged about 26 million pounds a month in early 1947 and promise to continue at a high rate, unless restricted by scarcities in foreign exchange.

A plentiful world supply of crude rubber at moderate prices seems assured for an indefinite period, assuming continued operation of one-third or more of the synthetic-producing capacity in the United States and the absence of serious political dislocations. The effects of stability in rubber prices, in contrast to the prewar gyrations, may be important in expanding the future use of rubber and hence demand for carbon black.

Beginning in mid-1946, the Government permitted gradual increases in the use of natural rubber by processors, the proportional amounts varying with specific product types. By the first quarter of 1947, the rubber industry was reported to be using about 35 percent natural and 65 percent synthetic rubbers.

No long-term policy with respect to the United States synthetic rubber plants has been defined by the Congress, but the strategic value of the industry from both commercial and national defense points of view is widely understood. It, therefore, seems generally agreed that a material portion of the productive capacity will be retained in an operating or stand-by condition. Continued use of important amounts of synthetic rubber will tend to increase sales of carbon black over the amount required for natural rubber processing and to strengthen the position of furnace blacks relative to channel.

PRODUCTION

By States.—Texas production increased 15 percent over 1945 to 830,850,000 pounds, amounting to 67 percent of the United States total in 1946, compared with 69 percent in 1945. Rapid expansion in districts other than the Panhandle continued in 1946 owing in large part to the Government-built channel-type plants that utilize large quantities of gas produced with oil. Output in these districts of 234,172,000 pounds of carbon black in 1946 was 30 percent above 1945 and over four times that of 1942.

Production increased in all other producing States, except California, record output being reported in Kansas, Louisiana, New Mexico, and Oklahoma.

By Months.—The adjacent table showing monthly production of carbon black in 1946 has been prepared on a similar basis to those published for 1941 and earlier years, with the addition of a separation between the contact and furnace (including thermal) types of black. The Bureau of Mines annual totals are prorated on the basis of the monthly figures supplied through the courtesy of the National Gas Products Association. These data are compiled from reports submitted to the association by carbon-black producing companies.

Carbon black produced from natural gas in the United States in 1946, by States and by major producing districts

State and district	Producers reporting [1]	Number of plants	Production			Natural gas used			
			Pounds	Value at plant		M cubic feet	Average yield per M cubic feet of gas (pounds)	Value	
				Total	Average (cents)			Total	Average per M cubic feet (cents)
California	1	1	126,134,000	$5,239,000	4.15	18,504,000	6.82	$777,000	4.20
Kansas	3	3							
Louisiana	6	6	191,857,000	7,700,000	4.01	26,833,000	7.15	913,000	3.40
New Mexico	3	3	35,636,000	1,912,000	5.37	25,148,000	1.42	659,000	2.62
Oklahoma	3	4	59,944,000	2,436,000	4.06	14,561,000	4.12	672,000	4.62
Texas:									
Panhandle district	16	32	[2] 596,678,000	30,830,000	5.17	313,725,000	1.65	9,701,000	3.09
Rest of State	4	11	234,172,000	11,871,000	5.07	79,578,000	2.94	1,748,000	2.20
Total Texas	[1] 17	43	[2] 830,850,000	42,701,000	5.14	393,303,000	1.91	11,449,000	2.91
Total United States	[1] 22	60	[2] 1,244,421,000	59,988,000	4.82	478,349,000	2.44	14,470,000	3.02

[1] In counting the total number of producers reporting, a producer operating in more than one State, district, or county is counted but once.
[2] Includes carbon black made from liquid hydrocarbons.

Carbon black produced from natural gas [1] in the United States in 1946, by months in thousands of pounds

Month	National Gas Products Association [2]			Bureau of Mines [3]			
	Contact	Furnace	Total	Contact	Furnace	Total	Daily average
January	52,697	35,763	88,460	52,695	40,020	92,715	2,991
February	48,013	36,154	84,167	48,012	40,645	88,657	3,166
March	53,583	45,032	98,615	53,581	50,650	104,231	3,362
April	52,464	50,132	102,596	52,462	56,278	108,740	3,625
May	53,153	53,779	106,932	53,151	60,030	113,181	3,651
June	49,827	51,699	101,526	49,825	57,529	107,354	3,578
July	52,821	54,176	106,997	52,819	60,655	113,474	3,660
August	53,489	51,601	105,090	53,487	57,529	111,016	3,581
September	48,961	45,207	94,168	48,959	50,550	99,509	3,317
October	50,810	43,695	94,505	50,808	48,875	99,683	3,216
November	50,067	44,619	94,686	50,065	50,025	100,090	3,336
December	53,247	46,688	99,935	53,245	52,526	105,771	3,412
Total	619,132	558,545	1,177,677	619,109	625,312	1,244,421	3,409

[1] Includes carbon black made from liquid hydrocarbons.
[2] Excludes data for some producers.
[3] Monthly figures estimated by allocating the Bureau's annual total proportionately to the association's monthly data.

Methods and Yields.—An average yield in 1946 of 2.44 pounds of carbon black of all grades compared with 2.32 pounds in 1945, prolonging the upward trend that has been caused by the growing importance of furnace black. The furnace plants consumed 62,741 million cubic feet of natural gas and over 20 million gallons of liquid hydrocarbons in 1946. Their indicated yield of black from natural gas exceeded 8.5 pounds per thousand cubic feet consumed.

The contact-type plants used 415,608 million cubic feet of natural gas in 1946, with an average yield of 1.49 pounds per thousand cubic

feet, compared with 1.42 pounds in 1945 and 1.32 pounds in 1944. Recent higher yields are doubtless related to less emphasis upon production of the easy-processing grades than in 1944 and 1943. The principal sources of contact-type blacks are the Texas Panhandle, West Texas, and New Mexico.

Number and Capacity of Plants.—The number of operating plants increased from 59 in 1945 to 60 in 1946, of which 42 were contact types and 18 furnace. Two new furnace plants began operations—(1) at Hickok, Grant County, Kans., owned by the Columbian Carbon Co., and (2) at Brazoria, Brazoria County, Tex., owned by the Jefferson Lake Sulphur Co. One channel plant, of the Texas Elf Carbon Co. at Eliasville, Stephens County, Tex., did not operate.

Six Government-owned channel plants, in Texas (3), New Mexico (2), and Oklahoma (1), were offered for sale or lease by the War Assets Administration on May 1, 1947. The aggregate cost to the Government of these plants was $20,282,000, and their total rated capacity 126 million pounds of black a year.

Number and capacity of carbon black plants operated in the United States, 1945–46

State or district	County or parish	Number of plants				Total daily capacity (pounds)	
		1945		1946		1945	1946
		Contact	Furnace	Contact	Furnace		
California	Contra Costa	------	1	------	1	328,000	381,700
Kansas	Grant	1	1	1	2		
Louisiana	Avoyelles	------	1	------	1	679,200	664,700
	Evangeline	------	1	------	1		
	Ouachita	2	2	2	2		
Total Louisiana		2	4	2	4	679,200	664,700
New Mexico	Lea	3	------	3	------	97,600	105,400
Oklahoma	Pontotoc	1	------	1	------	209,000	212,000
	Texas	1	2	1	2		
Total Oklahoma		2	2	2	2	209,000	212,000
Texas:							
Panhandle district	Carson	[1] 1	------	[1] 1	------	1,657,000	1,669,600
	Gray	7	1	7	1		
	Hutchinson	[1] 13	2	[1] 13	2		
	Moore	7	1	7	1		
		28	4	28	4	1,657,000	1,669,600
Rest of State	Aransas	1	1	1	1	662,800	625,000
	Brazoria	------	------	------	1		
	Ector	1	------	1	------		
	Gaines	1	------	1	------		
	Harris	------	1	------	1		
	Montgomery	------	1	------	1		
	Nueces	1	------	1	------		
	Stephens	1	------	------	------		
	Terry	------	1	------	1		
	Ward	1	------	1	------		
	Winkler	1	------	1	------		
		7	4	6	5	662,800	625,000
Total Texas		35	8	34	9	2,319,800	2,294,600
Total United States		43	16	42	18	3,633,600	3,658,400

[1] One plant in both Carson and Hutchinson Counties tabulated under Hutchinson County.

The productive capacity of all producing plants in 1946 amounted to 3,658,400 pounds per day compared with 3,633,600 pounds in 1945, a net gain of less than 1 percent. Furnace plant capacity increased from 1,863,000 to 1,953,000 pounds per day, but that of contact plants declined from 1,770,600 to 1,705,400 pounds. Except for the plants built with Government funds, installed capacity to produce channel black had changed little during the war. The investment of private money in new productive facilities has been directed toward furnace-type processes. Production in 1946 equaled 93 percent of total reported capacity at the end of the year, compared with 79 percent in 1945.

Producers.—The Jefferson Lake Sulphur Co. was added to the list of producers in 1946, raising the total to 22 from 21 in 1945.

DOMESTIC DEMAND—SALES

Actual consumption can be only approximated because of the lack of data on consumers' inventories, but sales by carbon-black producers in the United States doubtless correlate rather closely with consumption, in the absence of large production abroad. Such sales, amounting in the first full postwar year (1946) to 1,270 million pounds were 24 percent above 1945 and exceed 1946 production by 25 million pounds. They probably provided for some accumulation of working inventory by processing industries, particularly in foreign countries that had been deprived of carbon black for several years. Sales for export increased sharply (56 percent) to record levels with the resumption of peacetime manufacturing in many foreign countries, accounting for 21 percent of total deliveries in 1946 compared with 17 percent on 1945.

The indicated sales of contact (channel) process blacks were 667 million pounds and those of furnace blacks, 603 million pounds. The demand for channel blacks in 1946 and through the early months of 1947 apparently exceeded the capacity of the industry to produce. Demand for furnace blacks was below productive capacity in 1946 but expanded in early 1947 to approximate the level of reported capacity.

All types of users contributed to the 18-percent gain in domestic deliveries in 1946 to a new high of 998,655,000 pounds of carbon black.

The rubber industry absorbed 941,464,000 pounds or 17 percent more than in 1945, but its share of domestic sales declined to 94 percent from 95 percent in 1944 and 1945. Although total sales to rubber companies in 1946 were greater than in any previous year, they were about 10 percent less per ton of crude rubber consumed than in 1945. This decline may be attributed to the shift away from production of military items to civilian goods, such as the smaller sizes of tires, and to the increasing use of natural rubber by the processing companies.

With the removal of Government controls on inks and carbon black, sales to ink companies increased to 29,561,000 pounds in 1946 from 22,824,000 pounds in 1945. Similarly, an increase in the apparent consumption of newsprint in the United States to 4,296,268 short tons in 1946 from a revised total of 3,481,302 short tons in 1945, was reported by the American Newspaper Publishers' Association. Paint companies' requirements, influenced by growing markets for

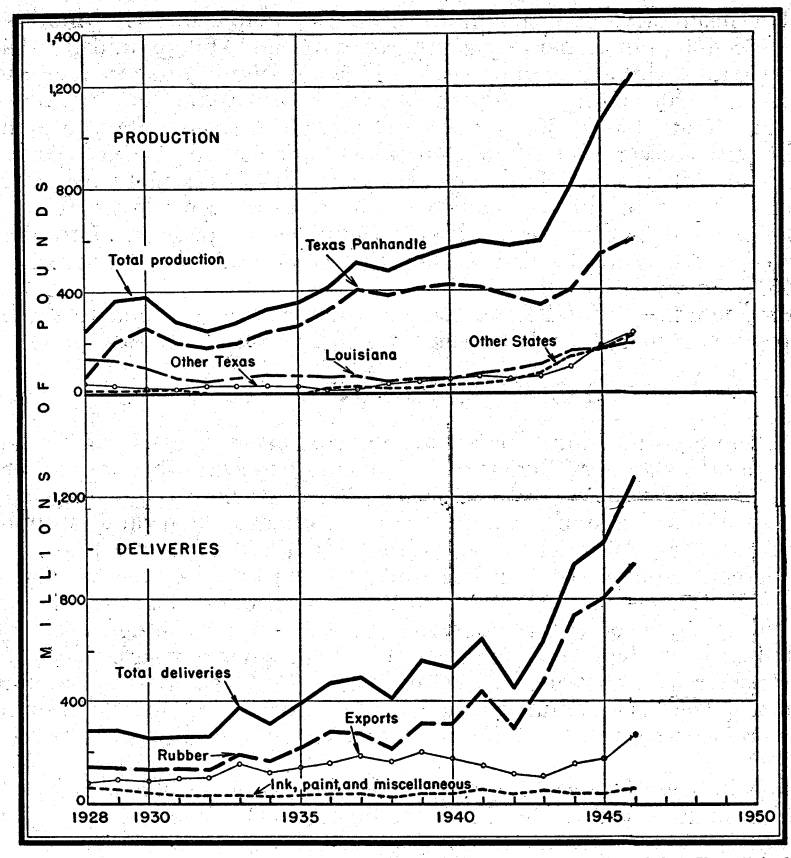

FIGURE 2.—Production and deliveries of carbon black 1928-46. Production in "Other Texas" includes Oklahoma and Wyoming in 1932-35.

automotive and other coatings, expanded 25 percent over 1945 to 9,312,000 pounds.

Sales to miscellaneous users of 18,318,000 pounds of black were 57 percent greater than in 1945 but below the record volume taken in 1943, when an abnormal amount of carbon black was used for military purposes.

STOCKS

The increase in producers' inventory of contact blacks that had continued through the latter half of 1945 was reversed early in 1946, and thereafter a declining trend persisted through the end of the year, when stocks amounted to only 17,006,000 pounds (less than 2 weeks' supply)—the lowest total in over 20 years.

Stocks of furnace blacks did not change significantly during the first 2 quarters of 1946 from the opening level of 37,049,000 pounds. They were built up to about twice this level in the third quarter and then declined to 59,222,000 pounds on December 31 as sales increased.

PRICES

The increase in average value of carbon black at the plants from 4.02 cents a pound in 1945 to 4.82 cents in 1946 was related primarily to higher prices for channel black made possible by relaxation of price controls.

The average value at the plants of contact-type blacks increased from 4.11 cents a pound in 1945 to 5.49 cents in 1946; similarly, furnace-black values were 3.93 and 4.15 cents for the same years. The average value of contact blacks relative to the furnace types has risen from 0.34 cent a pound less than the furnace average in 1944 to 1.34 cents above it, thus reversing the economic position of the two major classes of carbon black.

Early in August the Office of Price Administration suspended price controls on the principal grades of channel black, and the price of standard channel at the plants advanced from 5.0 to 5.5 cents a pound for carload shipments in bulk, in the form of pellets or beads. Another increase to 6.0 cents a pound became effective on January 1, 1947. All grades of channel black were released from control on October 9, 1946. Prices of the principal grades of furnace black were unchanged during 1946.

FOREIGN TRADE[1]

Exports.—The resumption of rubber processing in many European countries in 1946 stimulated exports of carbon black to the record volume of 271,084,780 pounds, 56 percent above 1945. In the European region, 15 countries received 167,023,695 pounds of carbon black from the United States in 1946. Shipments to France increased from less than 4 million pounds in 1945 to 47 million pounds in 1946. Most of the Latin American countries imported more carbon black than in 1945 or prewar years.

Export shipments were at a high rate throughout 1946, except in the August–October period when they were curtailed by widespread strikes in United States ports. The average value of the carbon black exported was 6.67 cents a pound in 1946 compared with 5.66 cents in 1945.

Because of the lower railroad freight costs from producing points to tidewater, the great bulk of ocean-borne exports clears through Gulf ports, led by those of the Galveston customs district, which handled more than half of total exports in 1946.

Imports.—With disappearance of wartime requirements, the import movement of "gas black and carbon black" from Canada shrank to 22,932 pounds valued at 10.4 cents a pound in 1946 from the peak of 1,526,758 pounds in 1945. Imports of 440 pounds from Mexico and 40 pounds from the United Kingdom were also reported. Imports of acetylene black from Canada also felt the lack of war stimulus in 1946, declining to 3,945,836 pounds valued at 10.2 cents a pound from 7,583,370 pounds in 1945 valued at 9.76 cents.

[1] Figures on exports and imports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Carbon black exported from the United States, 1945–46, by months and customs districts

	1945		1946	
	Pounds	Value	Pounds	Value
Jan.	14,881,600	$714,604	22,537,237	$1,497,248
Feb.	8,646,100	399,826	20,490,648	1,229,154
Mar.	15,556,459	798,195	22,736,800	1,345,355
Apr.	10,201,823	520,884	27,090,224	1,693,935
May	13,308,061	734,889	25,580,264	1,858,360
June	12,014,691	661,363	33,115,392	2,126,954
July	12,254,969	696,114	23,278,122	1,512,826
Aug.	14,243,030	826,223	14,406,255	1,055,410
Sept.	14,715,600	902,545	16,023,199	1,211,438
Oct.	20,377,095	1,272,413	11,753,099	803,578
Nov.	19,169,083	1,148,361	22,413,704	1,449,799
Dec.	18,404,107	1,155,436	31,659,836	2,304,375
	173,772,618	9,830,853	271,084,780	18,088,432

Customs district	1945		1946	
	Pounds	Value	Pounds	Value
Buffalo	418,209	$24,566	285,369	$18,837
El Paso	1,084,125	53,981	1,376,435	79,384
Galveston	74,068,697	4,484,931	146,697,477	10,431,510
Georgia	18,114,100	1,025,513	12,507,350	705,777
Laredo	3,640,774	178,966	2,267,411	115,747
Michigan	44,129,131	1,966,117	47,181,747	2,411,320
Mobile	1,100	169	3,260,255	178,701
New Orleans	22,155,014	1,448,970	36,833,367	2,471,918
New York	1,709,310	135,559	6,670,866	528,898
Philadelphia	1,319,513	81,464	1,889,750	116,931
San Francisco	6,177,005	362,471	10,297,387	882,268
Other districts	955,640	68,146	1,817,366	147,141
	173,772,618	9,830,853	271,084,780	18,088,432

Carbon black exported from the United States, 1944–46, by countries

Country	1944		1945		1946	
	Pounds	Value	Pounds	Value	Pounds	Value
Argentina	568,735	$36,523	2,382,148	$171,618	6,988,074	$602,767
Australia	6,393,433	360,755	15,407,249	982,087	12,523,962	1,015,150
Belgium and Luxembourg			3,018,925	202,515	3,731,625	265,362
Brazil	4,067,702	214,220	5,319,529	334,799	6,403,875	466,474
Canada	39,059,668	1,510,720	45,103,317	2,019,005	42,087,414	2,036,554
Chile	239,738	13,613	475,800	30,624	965,885	63,808
China					4,521,187	425,975
Colombia	151,916	9,510	717,668	45,252	565,139	54,862
Cuba	1,088,675	58,626	880,985	57,143	1,028,072	72,066
Czechoslovakia					2,974,425	165,960
Denmark			271,155	31,370	1,766,495	126,013
Egypt	30,450	2,507	48,600	3,523	44,000	2,640
Eire			15,450	2,782	1,375,550	110,626
France			3,837,000	243,973	46,698,747	2,954,845
Finland					2,029,210	148,825
Guatemala	17,225	1,135	14,575	1,274	28,400	1,707
India and Dependencies	12,114,361	630,535	5,606,928	351,029	8,126,276	576,511
Italy	112,050	9,110			10,119,318	608,382
Mexico	3,329,528	141,342	4,835,794	240,050	6,224,266	328,486
Netherlands			136,500	11,852	4,031,610	297,173
New Zealand	894,067	49,176	722,455	41,523	840,326	83,423
Norway			844,350	53,947	1,787,925	113,523
Peru	242,434	12,410	456,435	29,629	490,956	38,867
Portugal	51,257	3,058	520,913	32,374	746,752	53,761
Spain	947,750	50,949	1,051,630	62,350	5,971,900	399,665
Sweden	1,455,408	63,499	1,793,935	120,469	6,949,230	478,407
Switzerland	110,250	7,758	280,900	21,306	2,461,045	204,023
Union of South Africa	9,413,576	464,453	8,335,514	539,659	8,598,967	649,627
U. S. S. R.	4,204,458	256,170	803,445	48,440	555,000	50,227
United Kingdom	71,333,550	3,492,115	69,549,113	4,039,658	75,824,863	5,367,506
Other countries	1,164,289	69,185	1,342,305	112,602	4,624,286	325,217
	156,990,520	7,457,369	173,772,618	9,830,853	271,084,780	18,088,432

Cement

By G. RICHARDS GWINN AND ESTHER V. BALSER

	PAGE
General summary	207
Salient statistics	208
Portland cement	210
Production, shipments, and stocks	210
Domestic consumption	214
Local supplies	218
Transportation	218
Mill values	219
Capacity of plants	220
Clinker production	221
Portland cement—Continued.	
Production according to raw materials	223
Raw materials	224
Fuels and power	224
Types of cement	226
Technologic developments	227
Natural, masonry (natural), and puzzolan cements	228
Foreign trade	229
World review	231

GENERAL SUMMARY

PRODUCTION and demand for cement in 1946 increased sharply over the previous year's total and were far above estimates made at the beginning of the year. Total production of 166,538,862 barrels of hydraulic cements was 60 percent higher than in 1945 and only 10 percent lower than the 1942 record volume of 185,341,609 barrels. The gains were shared by all types (portland cement and the group of all other hydraulic cements—natural, masonry, puzzolan, and hydraulic-lime). The portland-cement industry operated at 68 percent and the "all other" group at 72 percent of productive capacity in 1946. Mill shipments of portland cement, which totaled 169,567,593 barrels, were 59 percent above that reported in 1945. Shipments of the "all other" group gained 71 percent. Stocks of all hydraulic cements at mills on December 31, 1946, were 11,063,262 barrels, 33 percent less than at the close of 1945.

The average net mill realization per barrel of portland cement increased 9 cents from the 1945 price, reaching $1.72 per barrel. "All other hydraulic cements," as a group, reported a gain of 22 cents a barrel to $1.64.

The long-term trend, as shown by the moving 12-month total of production of finished portland cement, continued the upswing that started in April 1945 and by the end of 1946 had reached a point comparable to that of July 1943, only 10 percent below the all-time high of 182,652,000 barrels reached in 1942.

Monthly production of cement diverged from the normal peacetime trend as well as from the previous year's pattern. February production was only 385,000 barrels below the January total. March and April output follow the normal trend, but a slight decrease occurred in May in contrast to the usual continued rise during the spring

months. From June to September, the peak month, the monthly increase was above the normal rate.

The accompanying table presents the principal statistics of the cement industry over a 5-year period.

Salient statistics of the cement industry in the United States, 1942–46 [1]

	1942	1943	1944	1945	1946
Production of finished cement:					
Portland—barrels	182,781,184	133,423,788	90,905,696	102,804,884	164,064,188
Masonry, natural, and puzzolan (slag-lime)—barrels	2,560,425	1,830,266	1,246,703	1,483,763	2,474,674
Total production—do	185,341,609	135,254,054	92,152,399	104,288,647	166,538,862
Capacity used at portland-cement mills—percent	73.5	55.0	37.8	42.5	67.9
Production of portland-cement clinker [2]—barrels	181,267,461	135,692,400	90,508,803	102,702,976	165,126,403
Active plants:					
Portland	155	153	151	145	153
Masonry, natural, and puzzolan (slag-lime)	11	10	9	9	9
Shipments from mills:					
Portland—barrels	185,300,884	127,631,859	94,271,881	106,353,595	169,567,593
Value [3]	$283,237,028	$200,103,216	$150,357,754	$173,337,010	$292,393,333
Per barrel	$1.53	$1.57	$1.59	$1.63	$1.72
Masonry, natural, and puzzolan (slag-lime)—barrels	2,508,324	1,846,803	1,320,274	1,479,513	2,533,106
Value [3]	$3,668,169	$2,357,112	$1,638,892	$2,093,848	$4,155,171
Per barrel	$1.46	$1.28	$1.24	$1.42	$1.64
Total shipments—barrels	187,809,208	129,478,662	95,592,155	107,833,108	172,100,699
Value	$286,905,197	$202,460,328	$151,996,646	$175,430,858	$296,548,504
Stocks at mills, Dec. 31:					
Portland:					
Finished cement—barrels	17,380,273	23,188,975	19,952,711	[4] 16,454,775	[5] 10,951,370
Clinker [2]—do	3,509,336	5,959,170	5,328,986	[4] 4,462,633	[5] 3,873,740
Masonry, natural, and puzzolan (slag-lime)—barrels	253,307	227,152	166,889	[4] 170,324	[5] 111,892
Imports—do	644	13,658	169	323	3,734
Exports—do	1,100,826	1,731,956	4,040,405	6,476,333	5,163,362
Apparent consumption—do	186,709,026	127,760,364	91,551,919	101,357,098	166,941,071

[1] Includes Hawaii.
[2] Compiled from monthly reports by producers.
[3] Value received f. o. b. mill, excluding cost of containers.
[4] Revised figure.
[5] Subject to revision.

Monthly shipments from mills in 1946, with the exception of February and June, followed essentially the prewar trend but at a much higher volume level, increasing steadily, with the exception of a slight decline in June, from a January total of 7,391,000 barrels to a peak of 17,955,000 barrels in August, followed by a decline in September, a slight increase in October, and a sharp decline to 11,494,000 barrels in December.

Consumption trends of portland cement in 1946, as shown in figure 1, varied little from the previous year. The over-all change was only 0.5 percent from the 1945 totals.

The Middle States in 1946 were again the leading consuming region.[1]

A vigorous program of rehabilitation and expansion of cement plants was started in 1946, and the industry seems to be divided between plans of expansion and efforts to increase the efficiency of the present equipment. Despite fuel shortages, strikes, and difficulties in

[1] The States comprising each region are found in Bureau of Mines Minerals Yearbook, 1945, p. 1222.

obtaining materials, shortages that developed during the year were local, and the general supply situation was not critical.

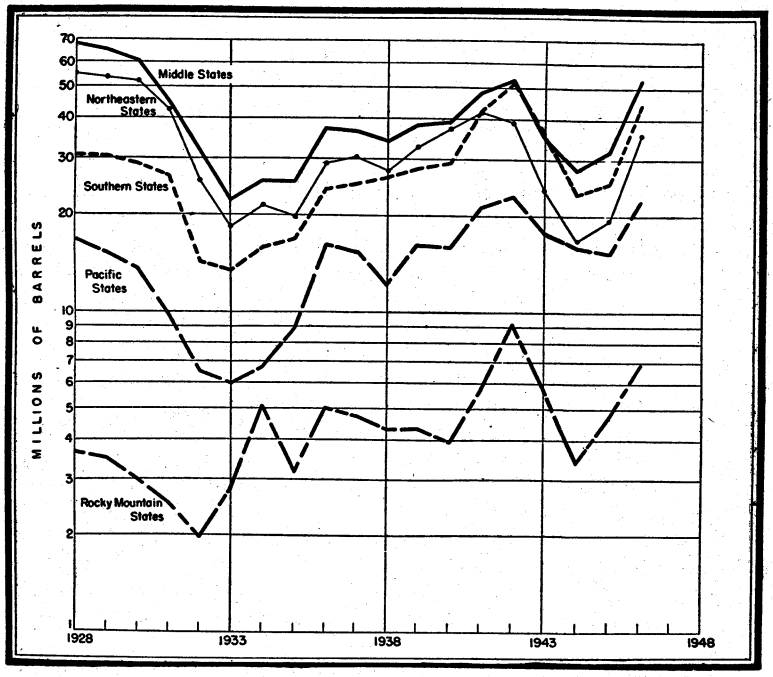

FIGURE 1.—Trends of indicated consumption of portland cement in continental United States, 1928–46, by regions.

The United States Circuit Court of Appeals on September 20, 1946, vacated the Federal Trade Commission antitrust order affecting a group of cement-producing companies and thus upheld the producers' right to absorb freight costs where necessary to meet the prices of competitors located nearer a particular market.

Maximum Price Regulation Order–224 of the Office of Price Administration was amended six times during 1946. Two of these were added only to clarify previous amendments. Increases of 30 cents a barrel were allowed in Arizona, that part of California south of and including Santa Barbara, Kern, Inyo, and Mono Counties, and Clark and Lincoln Counties in Nevada, effective April 22, 1946. Effective June 15, 1946, a ceiling was set on cement in bulk, f. o. b. mill, in districts as listed by the Bureau of Mines in 1941; effective July 26, 1946, an increase of 5 cents per barrel was granted to cement manufacturers in Texas, when the cement is sold in containers and the destination of shipments is within the State of Texas; effective November 1, 1946, an increase not to exceed 15 cents per barrel was granted to producers in California, north of but not including Santa Barbara, Kern, Inyo, and Mono Counties, and that part of Nevada north of but not including Clark and Lincoln Counties, if the destination of shipment is within the area defined.

PORTLAND CEMENT

PRODUCTION, SHIPMENTS, AND STOCKS

The production of portland cement constituted 99 percent of the total output of hydraulic cements in 1946.

Portland cement was manufactured at 152 plants in 1946, and shipments were made from 153 plants in 34 States, Hawaii, and Puerto Rico. However, the plant in Hawaii closed at the end of 1946 and is being dismantled. One plant shipped from stock. The leading States, in order of production, were Pennsylvania, California, Texas, Michigan, and Ohio.

Production in 1946 was higher in all Bureau of Mines districts than in 1945. In continental United States the increases ranged from 19 percent in the Virginia-Georgia-Florida-Louisiana district to 117 percent in the western Pennsylvania-West Virginia district.

Shipments in 1946 were also greater in all districts than in 1945. The gains range from 27 percent in California to 111 percent in the western Pennsylvania-West Virginia district.

Stocks of finished cement were 33 percent lower on December 31, 1946, than on the same date in 1945. Decreases occurred in all districts except New York and Maine, which showed an increase of 5 percent, and Puerto Rico, which reported an increase of 56 percent. The decreases ranged from 14 percent in western Pennsylvania and West Virginia to 66 percent in Iowa. Stocks of clinker in 1946 followed essentially the normal trend of an increase from January through March and a decline from March to the year's low in November.

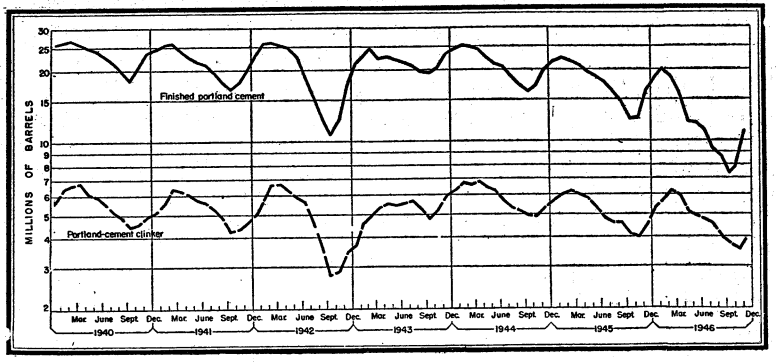

FIGURE 2.—Trends in end-of-month stocks of finished portland cement and portland-cement clinker, 1940–46.

Finished portland cement produced, shipped, and in stock in the United States, 1945–46, by districts

District	Active plants		Production			Shipments from mills							Stocks at mills on Dec. 31		
			Barrels			1945			1946				Barrels		
							Value			Value		Percent of change from 1945 in—			
	1945	1946	1945	1946	Percent of change from 1945	Barrels	Total	Average	Barrels	Total	Average	Barrels	Average value	1945	1946 [1]	Percent of change from 1945
Eastern Pennsylvania and Maryland	19	21	14,511,861	26,489,149	+82.5	15,138,863	$23,838,615	$1.57	26,897,558	$43,601,389	$1.62	+77.7	+3.2	[2] 2,386,265	1,977,856	−17.1
New York and Maine	11	12	5,617,380	11,411,868	+103.2	5,974,500	9,749,672	1.63	11,350,167	19,149,446	1.69	+90.0	+3.7	[2] 1,371,921	1,433,622	+4.5
Ohio	8	9	4,604,294	8,034,762	+74.5	4,833,183	7,356,271	1.52	8,187,531	13,293,126	1.62	+69.4	+6.6	[2] 667,544	514,775	−22.9
Western Pennsylvania and West Virginia	8	8	3,100,859	6,741,134	+117.4	3,248,624	5,002,388	1.54	6,843,407	10,959,691	1.60	+110.7	+3.9	[2] 744,203	641,930	−13.7
Michigan	7	9	5,839,190	9,693,767	+66.0	6,243,322	9,937,834	1.59	9,974,692	16,727,145	1.68	+59.8	+5.7	1,431,445	1,150,520	−19.6
Illinois	4	4	4,366,928	6,270,252	+43.6	4,189,449	7,089,118	1.69	6,675,584	11,646,747	1.74	+59.3	+3.0	[2] 817,332	412,000	−49.6
Indiana, Kentucky, and Wisconsin	6	6	6,224,200	10,571,385	+69.8	6,426,018	10,401,400	1.62	10,792,114	18,073,335	1.67	+67.9	+3.1	[2] 841,870	621,141	−26.2
Alabama	6	7	5,541,591	7,897,157	+42.5	5,682,692	8,359,286	1.47	8,071,979	13,120,084	1.63	+42.0	+10.9	484,871	310,049	−36.1
Tennessee	6	6	2,881,505	5,218,370	+81.1	2,898,053	4,669,330	1.61	5,372,964	9,386,582	1.75	+85.4	+8.7	614,547	459,953	−25.2
Virginia, Georgia, Florida, and Louisiana	6	6	4,744,080	5,656,967	+19.2	4,679,641	7,776,776	1.66	5,950,863	10,652,900	1.79	+27.2	+7.8	[2] 531,786	237,890	−55.3
Iowa	5	5	3,194,164	5,513,070	+72.6	3,527,838	6,220,991	1.76	6,145,326	11,312,627	1.84	+74.2	+4.5	962,821	330,565	−65.7
Eastern Missouri, Minnesota, and South Dakota	6	6	3,860,978	7,641,752	+97.9	4,351,766	7,395,708	1.70	8,128,243	14,541,928	1.79	+86.8	+5.3	[2] 960,478	473,987	−50.7
Kansas	6	6	3,000,731	6,404,648	+113.4	3,298,923	5,157,991	1.56	6,894,353	11,574,910	1.68	+109.0	+7.7	[2] 835,058	345,353	−58.6
Western Missouri, Nebraska, Oklahoma, and Arkansas	6	6	3,469,932	5,703,483	+64.4	3,593,201	5,829,009	1.62	6,165,696	10,549,732	1.71	+71.6	+5.6	727,739	265,526	−63.5
Texas	10	10	8,036,515	10,712,538	+33.3	8,388,159	14,790,545	1.76	10,996,478	19,946,600	1.81	+31.1	+2.8	[2] 661,404	377,464	−42.9
Colorado, Wyoming, Montana, Utah, and Idaho	8	8	3,021,587	4,088,203	+35.3	3,117,821	6,176,878	1.98	4,384,860	9,687,617	2.21	+40.6	+11.6	[2] 519,302	222,645	−57.1
California	11	12	15,951,762	19,540,790	+22.5	15,921,965	23,517,146	1.48	20,173,231	33,906,675	1.68	+26.7	+13.5	[2] 1,300,916	668,475	−48.6
Oregon and Washington	9	9	3,372,943	4,706,979	+39.6	3,342,388	7,048,478	2.11	4,812,993	10,320,602	2.14	+44.0	+1.4	[2] 562,164	456,150	−18.9
Puerto Rico	2	2	1,442,305	1,729,909	+19.9	1,474,447	2,951,348	2.00	1,711,549	3,825,506	2.24	+16.1	+12.0	33,109	51,469	+55.5
Hawaii	1	1	22,079	38,005	+72.1	22,742	68,226	3.00	38,005	116,691	3.07	+67.1	+2.3			
	145	153	102,804,884	164,064,188	+59.6	106,353,595	173,337,010	1.63	169,567,593	292,393,333	1.72	+59.4	+5.5	[2] 16,454,775	10,951,370	−33.4
Pennsylvania	22	24	15,563,738	29,202,494	+87.6	16,232,722	25,549,621	1.57	29,686,909	48,294,891	1.63	+82.9	+3.8	[2] 2,809,915	2,325,500	−17.2
Missouri	5	5	3,185,227	6,511,905	+104.4	3,681,632	6,134,452	1.67	6,887,517	12,142,018	1.76	+87.1	+5.4	[2] 787,092	411,480	−47.7

[1] Subject to revision.
[2] Revised figure.

Production, shipments from mills, and stocks at mills of finished portland cement in the United States in 1946, by months and districts, in thousands of barrels

District	January	February	March	April	May	June	July	August	September	October	November	December
PRODUCTION												
Eastern Pennsylvania and Maryland	1,687	1,489	1,902	1,921	1,672	2,239	2,429	2,677	2,673	2,751	2,586	2,459
New York and Maine	418	520	720	895	825	1,087	1,019	1,156	1,267	1,155	1,223	1,134
Ohio	550	393	624	612	607	689	733	817	830	825	737	617
Western Pennsylvania and West Virginia	368	246	342	468	515	606	690	688	740	732	746	600
Michigan	560	540	278	564	842	964	1,021	1,065	1,040	1,105	978	738
Illinois	343	445	429	415	242	462	611	673	774	747	590	539
Indiana, Kentucky, and Wisconsin	608	680	601	955	652	888	978	1,149	1,009	1,137	1,052	863
Alabama	501	512	594	610	546	642	724	751	700	732	711	706
Tennessee	183	206	382	355	265	397	578	540	575	553	544	569
Virginia, Georgia, Florida, and Louisiana	386	371	462	506	409	513	531	567	530	462	412	509
Iowa	377	360	359	353	371	478	542	561	627	589	488	409
Eastern Missouri, Minnesota, and South Dakota	402	283	482	560	637	822	810	700	783	838	697	628
Kansas	333	279	427	494	528	636	553	617	570	710	625	633
Western Missouri, Nebraska, Oklahoma, and Arkansas	375	332	377	454	470	472	492	533	564	566	556	504
Texas	787	742	998	871	888	970	977	977	1,011	768	742	982
Colorado, Wyoming, Montana, Utah, and Idaho	233	109	245	356	413	386	391	398	395	423	349	374
California	1,159	1,355	1,629	1,670	1,745	1,684	1,690	1,668	1,683	1,712	1,793	1,757
Oregon and Washington	234	250	298	432	317	437	504	495	530	472	354	376
Puerto Rico	128	138	151	154	143	110	146	180	144	129	149	159
Hawaii	3		5	5	4	7	1	1	5	4	3	1
United States: 1946	9,635	9,250	11,305	12,650	12,091	14,489	15,420	16,213	16,450	16,410	15,335	14,557
1945	6,379	5,371	6,398	7,084	8,086	8,929	9,237	9,921	9,826	11,104	10,705	9,772
SHIPMENTS												
Eastern Pennsylvania and Maryland	1,065	1,054	2,161	2,503	2,596	2,205	2,372	2,816	2,622	2,963	2,753	1,789
New York and Maine	315	274	712	968	1,198	1,058	1,150	1,398	1,319	1,403	1,001	575
Ohio	289	338	669	804	829	719	794	954	853	855	650	433
Western Pennsylvania and West Virginia	176	169	336	530	693	598	694	787	839	859	746	415
Michigan	324	293	641	980	1,106	915	1,019	1,178	1,114	1,166	821	419
Illinois	170	203	395	618	661	584	614	825	855	691	638	410
Indiana, Kentucky, and Wisconsin	340	400	725	1,022	1,104	920	1,125	1,237	1,079	1,148	1,029	663
Alabama	541	592	669	679	571	575	730	737	717	761	665	666
Tennessee	222	291	429	449	401	329	498	581	555	561	514	474
Virginia, Georgia, Florida, and Louisiana	442	472	543	551	424	499	557	566	534	475	430	458
Iowa	102	124	325	591	792	635	726	737	660	680	531	243
Eastern Missouri, Minnesota, and South Dakota	227	290	509	681	862	828	925	856	878	883	699	491
Kansas	249	327	497	583	623	511	654	739	738	745	602	626

Western Missouri, Nebraska, Oklahoma, and Arkansas	219	268	418	518	591	543	574	682	686	687	507	473
Texas	709	810	1,072	988	922	975	993	1,022	1,021	840	757	888
Colorado, Wyoming, Montana, Utah, and Idaho	177	207	349	445	453	430	411	411	431	434	328	309
California	1,432	1,362	1,709	1,810	1,713	1,693	1,771	1,752	1,620	1,929	1,656	1,735
Oregon and Washington	248	257	408	499	383	422	477	514	472	502	326	292
Puerto Rico	142	121	147	146	139	119	163	163	155	136	146	135
Hawaii	2	1	4	4	5	6	2	----------	5	3	4	----------
United States: 1946	7,391	7,853	12,718	15,369	16,066	14,564	16,249	17,955	17,153	17,721	14,803	11,494
1945	4,873	4,572	6,988	7,894	9,272	10,083	10,283	11,467	11,211	13,303	10,342	6,112
STOCKS (END OF MONTH)												
Eastern Pennsylvania and Maryland	3,009	3,443	3,184	2,613	1,679	1,713	1,770	1,631	1,683	1,470	1,301	1,971
New York and Maine	1,470	1,716	1,725	1,659	1,279	1,321	1,191	948	897	650	873	1,432
Ohio	927	983	938	746	524	495	435	298	275	244	331	515
Western Pennsylvania and West Virginia	934	1,010	1,017	956	777	785	780	681	582	455	457	642
Michigan	1,668	1,914	1,551	1,136	871	920	923	809	735	674	831	1,151
Illinois	995	1,237	1,269	1,070	648	525	522	367	283	336	284	413
Indiana, Kentucky, and Wisconsin	1,106	1,385	1,262	1,199	744	712	565	476	406	395	418	617
Alabama	444	365	290	224	195	262	256	270	253	224	269	310
Tennessee	576	492	444	351	214	283	363	323	343	335	365	460
Virginia, Georgia, Florida, and Louisiana	476	375	294	252	234	247	221	221	217	204	187	238
Iowa	1,238	1,475	1,508	1,273	849	692	508	332	299	208	165	331
Eastern Missouri, Minnesota, and South Dakota	1,138	1,131	1,104	983	758	752	635	479	384	340	338	474
Kansas	921	872	803	717	620	744	643	522	353	318	341	347
Western Missouri, Nebraska, Oklahoma, and Arkansas	883	947	906	842	721	650	567	418	296	175	224	256
Texas	737	669	595	478	443	437	422	376	366	295	283	377
Colorado, Wyoming, Montana, Utah, and Idaho	575	478	375	285	246	203	183	171	135	123	144	209
California	1,000	1,004	924	783	815	807	725	641	704	487	624	647
Oregon and Washington	538	503	422	359	288	303	330	302	370	340	367	451
Puerto Rico	18	35	39	47	51	42	25	42	31	24	28	51
Hawaii	----------	----------	1	1	1	1	----------	1	----------	1	----------	1
United States: 1946	18,653	20,034	18,651	15,974	11,957	11,894	11,064	9,308	8,612	7,298	7,830	[1] 10,893
1945	21,365	22,171	21,588	20,787	19,599	18,535	17,486	15,966	14,595	12,385	12,763	16,423

[1] Subject to revision.

Stocks of finished portland cement and portland-cement clinker at mills in the United States on December 31, and yearly range in end-of-month stocks, 1942–46

	Dec. 31 (barrels)	Range			
		Low		High	
		Month	Barrels	Month	Barrels
1942 Cement	17,380,273	October	10,624,000	March	25,832,000
1942 Clinker	3,509,000	do	2,733,000	April	6,656,000
1943 Cement	23,188,975	do	19,583,000	March	24,111,000
1943 Clinker	5,959,000	January	3,771,000	December	5,959,000
1944 Cement	19,952,711	October	16,049,000	February	25,073,000
1944 Clinker	5,329,000	November	4,856,000	April	6,687,000
1945 Cement	[1] 16,454,775	October	12,385,000	February	22,171,000
1945 Clinker	[1 2] 4,462,633	November	4,022,000	March	6,185,000
1946 Cement	[2 3] 10,951,370	October	7,298,000	February	20,034,000
1946 Clinker	[2 3] 3,873,740	November	3,512,000	March	6,281,000

[1] Revised figure.
[2] Includes Hawaii.
[3] Subject to revision.

DOMESTIC CONSUMPTION

The following table shows that the indicated consumption of portland cement in 1946 gained in all States. Ten States—Connecticut, Delaware, Georgia, Maine, Mississippi, New Hampshire, North and South Carolina, Tennessee, and Vermont—reported an increase of more than 100 percent over the previous year's total. Forty-three percent was consumed in seven States—California, New York, Texas, Pennsylvania, Ohio, Illinois, and Michigan.

Destination of shipments of finished portland cement from mills in the United States, 1944–46, by States

Destination	1944 (barrels)	1945 (barrels)	1946	
			Barrels	Percentage of change from 1945
Continental:				
Alabama	1,193,825	1,912,267	2,744,143	+43.5
Arizona [1]	577,030	740,332	1,171,168	+58.2
Arkansas	728,357	974,515	1,331,500	+36.6
California	12,047,681	11,791,720	17,341,128	+47.1
Colorado	694,058	1,134,256	1,726,667	+52.2
Connecticut [1]	863,538	996,729	2,120,160	+112.7
Delaware [1]	212,109	210,283	484,159	+130.2
District of Columbia [1]	667,007	765,140	1,011,075	+32.1
Florida	1,712,942	2,067,746	3,731,283	+80.5
Georgia	1,245,546	1,446,831	3,049,291	+110.8
Idaho	350,953	431,585	707,091	+63.8
Illinois	4,786,504	5,382,144	8,766,933	+62.9
Indiana	2,933,702	3,629,275	5,256,194	+44.8

See footnotes at end of table.

Destination of shipments of finished portland cement from mills in the United States, 1944–46, by States—Continued

Destination	1944 (barrels)	1945 (barrels)	1946	
			Barrels	Percentage of change from 1945
Iowa	1,996,258	2,186,491	3,758,932	+71.9
Kansas	1,821,219	1,771,706	2,954,100	+66.7
Kentucky	1,258,367	1,205,966	2,319,754	+92.4
Louisiana	1,588,674	1,928,381	2,563,968	+33.0
Maine	248,306	305,691	657,951	+115.2
Maryland	1,595,553	1,655,621	2,751,643	+66.2
Massachusetts [1]	1,084,005	1,298,674	2,526,515	+94.5
Michigan	3,770,473	4,636,388	7,570,738	+63.3
Minnesota	1,638,274	2,134,964	3,716,917	+74.1
Mississippi [1]	661,707	788,402	1,686,806	+114.0
Missouri	1,969,801	2,579,047	4,885,365	+89.4
Montana	259,048	355,504	553,373	+55.7
Nebraska	1,339,958	1,030,485	1,813,766	+76.0
Nevada [1]	261,849	310,060	400,329	+29.1
New Hampshire [1]	212,212	253,771	517,126	+103.8
New Jersey [1]	2,584,923	2,772,450	5,122,199	+84.8
New Mexico [1]	382,762	798,601	1,073,385	+34.4
New York	4,057,926	5,251,853	10,231,890	+94.8
North Carolina [1]	2,709,385	1,368,730	3,506,313	+156.2
North Dakota [1]	286,783	382,307	672,182	+75.8
Ohio	4,386,526	4,777,250	9,027,415	+89.0
Oklahoma	1,300,453	1,579,949	3,025,839	+91.5
Oregon	736,067	921,048	1,477,665	+60.4
Pennsylvania	4,798,187	5,474,146	9,702,251	+77.2
Rhode Island [1]	304,685	266,330	495,436	+86.0
South Carolina [1]	555,354	588,720	1,347,237	+128.8
South Dakota	288,421	383,393	727,561	+89.8
Tennessee	1,882,533	1,771,512	3,665,692	+106.9
Texas	5,219,577	6,594,518	9,904,082	+50.2
Utah	611,048	675,278	932,799	+38.1
Vermont [1]	116,599	157,590	378,325	+140.1
Virginia	2,434,028	2,065,911	3,492,109	+69.0
Washington	3,338,793	2,304,247	3,364,011	+46.0
West Virginia	902,932	1,080,405	2,006,952	+85.8
Wisconsin	2,259,571	2,608,043	4,443,029	+70.4
Wyoming	248,343	219,924	342,817	+55.9
Unspecified	184,727	490,825	36,397	−92.6
Total continental United States	87,308,579	96,457,004	163,093,661	+69.1
Outside continental United States [2]	6,963,302	9,896,591	6,473,932	−34.6
Total shipped from cement plants	94,271,881	106,353,595	169,567,593	+59.4

[1] Non-cement-producing State.
[2] Direct shipments by producers to foreign countries and to noncontiguous Territories (Alaska, Hawaii, Puerto Rico, etc.), including distribution from Puerto Rican and Hawaiian mills.

Destination of shipments of finished portland cement from mills in the United States in 1946, by months, in barrels

Destination	January	February	March	April	May	June	July	August	September	October	November	December
Alabama	141,938	164,435	210,388	216,042	225,632	215,742	270,938	258,998	258,239	288,369	247,330	221,853
Arizona	80,376	86,868	115,547	93,507	112,242	90,943	108,282	92,607	85,608	105,848	86,035	123,993
Arkansas	58,438	70,953	103,636	110,169	85,678	95,334	124,300	138,696	131,553	127,678	116,644	125,035
California	1,221,485	1,154,967	1,344,774	1,484,611	1,456,583	1,476,948	1,569,801	1,551,728	1,457,307	1,731,583	1,438,625	1,452,142
Colorado	95,458	101,489	132,483	167,187	172,624	163,550	163,331	157,711	174,579	165,397	110,322	121,913
Connecticut	73,968	54,730	135,322	184,335	244,257	174,444	189,210	244,939	244,782	273,861	196,430	102,206
Delaware	14,145	20,940	32,923	48,690	49,231	46,227	53,029	53,221	51,077	47,104	40,547	26,845
District of Columbia	45,372	50,518	95,714	93,965	84,866	70,727	84,616	94,139	80,625	111,140	119,961	79,109
Florida	304,947	298,101	339,417	367,222	244,912	251,144	365,315	308,077	259,360	269,580	367,597	351,974
Georgia	153,834	179,475	239,053	240,398	219,497	241,303	323,039	331,568	290,319	289,346	256,759	283,633
Idaho	26,967	34,158	70,102	79,461	66,826	74,252	71,067	61,222	60,269	63,520	49,681	43,841
Illinois	252,109	289,395	546,966	792,079	836,083	690,949	835,916	1,024,812	1,063,967	1,003,075	855,049	562,424
Indiana	157,500	210,657	385,077	495,577	545,335	407,760	493,529	666,050	587,594	530,737	453,379	348,334
Iowa	51,074	79,277	179,434	315,978	376,702	293,577	433,330	554,704	516,549	475,975	335,152	146,214
Kansas	107,834	136,173	231,324	258,473	296,989	234,015	259,498	299,899	313,569	324,456	244,914	246,108
Kentucky	59,084	82,197	165,507	223,217	215,702	209,531	254,814	261,707	235,886	233,459	222,323	155,455
Louisiana	162,897	176,783	206,262	212,656	216,927	233,361	232,382	242,879	251,757	172,536	150,964	214,455
Maine	7,619	6,028	22,460	44,498	72,036	65,911	77,842	108,895	84,485	87,139	55,866	24,348
Maryland	103,812	107,715	198,083	208,722	266,242	219,422	215,612	312,306	321,007	311,439	304,706	175,084
Massachusetts	67,763	59,549	158,821	218,045	281,736	212,794	232,426	272,977	284,304	324,204	259,393	146,598
Michigan	249,726	206,308	494,965	767,155	820,876	759,851	815,044	845,145	803,880	849,709	633,262	336,080
Minnesota	74,292	68,806	176,059	341,047	494,937	389,145	442,663	458,680	407,844	421,026	312,566	128,505
Mississippi	70,957	96,037	130,957	131,882	140,456	125,598	170,147	144,342	178,883	192,389	135,312	181,885
Missouri	174,027	228,094	368,588	418,342	425,204	410,540	479,494	462,699	524,723	530,042	447,328	364,886
Montana	13,729	16,306	35,471	65,791	58,293	52,501	57,640	60,166	68,822	73,092	39,273	12,691
Nebraska	46,037	55,348	120,754	170,214	198,290	183,069	185,596	217,845	206,523	183,596	134,748	110,190
Nevada	25,226	25,155	45,847	46,580	39,874	36,367	33,600	29,910	29,597	39,520	23,935	25,205
New Hampshire	11,423	10,753	23,301	42,910	63,617	38,786	44,758	59,758	62,436	62,599	48,821	23,229
New Jersey	209,184	195,491	384,438	472,669	544,853	401,986	461,820	583,227	508,781	590,716	482,068	309,738
New Mexico	67,679	89,607	85,950	99,518	107,694	99,978	92,938	83,953	85,871	76,175	75,433	111,198
New York	320,121	274,422	690,675	880,069	1,079,154	908,221	957,062	1,203,975	1,125,510	1,279,424	960,530	549,274
North Carolina	132,698	199,239	295,741	307,512	291,273	327,114	294,370	337,304	337,933	345,661	357,565	277,283
North Dakota	3,526	4,996	21,799	48,987	122,967	128,906	77,723	52,452	59,437	67,338	56,101	33,290
Ohio	305,088	327,883	646,809	828,156	841,535	750,971	882,551	1,067,282	1,044,615	1,056,758	820,807	452,129
Oklahoma	147,475	167,683	243,205	250,284	254,980	229,368	265,908	291,061	284,594	323,067	269,007	298,484
Oregon	83,721	95,762	129,330	139,143	135,868	132,970	142,143	146,377	124,619	127,062	108,530	109,361
Pennsylvania	319,353	310,114	630,101	844,003	965,698	807,372	934,984	1,149,388	1,121,421	1,196,938	913,861	513,583
Rhode Island	13,722	9,537	32,086	44,634	57,593	39,379	44,820	59,016	49,587	63,813	47,251	33,831
South Carolina	68,062	81,900	112,450	117,562	103,244	109,786	138,487	135,020	108,291	126,052	118,309	127,734
South Dakota	10,877	13,626	34,943	63,992	88,646	77,000	69,472	79,669	100,152	113,061	61,909	13,922
Tennessee	131,176	176,733	266,655	312,848	346,115	278,402	372,729	372,963	339,325	460,881	354,331	261,510
Texas	566,552	659,715	875,936	922,434	854,802	868,542	899,971	926,269	958,661	685,612	730,946	878,968
Utah	19,056	34,982	67,238	94,550	84,478	89,960	89,795	107,664	61,021	89,139	78,641	75,141
Vermont	4,377	5,327	16,230	31,695	43,460	29,086	26,493	50,201	60,856	64,540	35,265	6,813

Virginia	122,000	169,035	270,768	306,022	306,898	313,023	320,742	378,935	360,365	385,287	354,804	199,892
Washington	162,370	166,580	270,691	332,322	258,310	296,544	368,143	378,995	341,893	400,491	218,795	213,731
West Virginia	66,446	70,332	131,652	172,775	184,019	159,386	201,067	208,864	211,434	231,297	223,671	130,207
Wisconsin	99,926	101,798	194,214	384,539	550,959	452,460	463,752	595,250	518,069	498,613	395,034	194,946
Wyoming	9,085	8,643	17,228	35,041	37,336	35,589	34,859	34,035	41,849	38,028	29,956	21,048
Unspecified	0	33,014	40,833	6,007	3,331	21,725	0	6,823	[*] 0	0	2,214	1,840
Continental United States	6,714,531	7,267,634	11,768,207	14,533,515	15,574,860	14,021,559	15,727,048	17,564,403	16,879,828	17,508,372	14,381,950	10,953,158
Outside continental United States [1]	676,469	585,366	949,793	835,485	491,140	542,441	521,952	390,597	273,172	212,628	421,050	540,842
Total	7,391,000	7,853,000	12,718,000	15,369,000	16,066,000	14,564,000	16,249,000	17,955,000	17,153,000	17,721,000	14,803,000	11,494,000

[1] Shipments by producers to foreign countries and to noncontiguous Territories of the United States (Alaska, Hawaii, Puerto Rico, etc.), including distribution from Puerto Rican and Hawaiian mills.

LOCAL SUPPLIES

An indication of the surplus or deficiency in the quantity of cement locally available is shown in the following table. The comparison is based on shipments from mills and on consumption as shown by State receipts of mill shipments. In 1946 deficiencies occurred in two States, Hawaii, and four districts, compared with one State, Hawaii, and three districts in 1945. As shipments from mills in 1946 were greater in all States and districts than in the previous year, this is another indication of the high demand during the past year.

The total surplus of producing States in 1946 was distributed as follows: 22,538,241 barrels to non-cement-producing States and Alaska; 4,582,499 barrels to destinations outside continental United States (excluding local consumption of Puerto Rican and Hawaiian production); and 36,397 barrels to unspecified destinations.

Estimated surplus or deficiency in local supply of portland cement in cement-producing States, 1945–46, in barrels

State or division	1945			1946		
	Shipments from mills	Estimated consumption	Surplus or deficiency	Shipments from mills	Estimated consumption	Surplus or deficiency
Alabama	5,682,692	1,912,267	+3,770,425	8,071,979	2,744,143	+5,327,836
California	15,921,965	11,791,720	+4,130,245	20,173,231	17,341,128	+2,832,103
Hawaii	22,742	824,631	−801,889	38,005	433,040	−395,035
Illinois	4,189,449	5,382,144	−1,192,695	6,675,584	8,766,933	−2,091,349
Iowa	3,527,838	2,186,491	+1,341,347	6,145,326	3,758,932	+2,386,394
Kansas	3,298,923	1,771,706	+1,527,217	6,894,353	2,954,100	+3,940,253
Michigan	6,243,322	4,636,388	+1,606,934	9,974,692	7,570,738	+2,403,954
Missouri	3,681,632	2,579,047	+1,102,585	6,887,517	4,885,365	+2,002,152
Ohio	4,833,183	4,777,250	+55,933	8,187,531	9,027,415	−839,884
Pennsylvania	16,232,722	5,474,146	+10,758,576	29,686,909	9,702,251	+19,984,658
Puerto Rico	1,474,447	1,075,278	+399,169	1,711,549	1,432,567	+278,982
Tennessee	2,898,053	1,771,512	+1,126,541	5,372,964	3,665,692	+1,707,272
Texas	8,388,159	6,594,518	+1,793,641	10,996,478	9,904,082	+1,092,396
Colorado, Montana, Utah, Wyoming, and Idaho	3,117,821	2,816,547	+301,274	4,384,860	4,262,747	+122,113
Oregon and Washington	3,342,388	3,225,295	+117,093	4,812,993	4,841,676	−28,683
Georgia, Kentucky, Virginia, Florida, and Louisiana	5,432,609	8,714,835	−3,282,226	7,225,311	15,156,405	−7,931,094
Indiana, Wisconsin, Minnesota, Nebraska, Oklahoma, South Dakota, and Arkansas	9,936,385	12,340,624	−2,404,239	16,924,088	20,314,806	−3,390,718
Maryland and West Virginia	2,154,765	2,736,026	−581,261	4,054,056	4,758,595	−704,539
New York and Maine	5,974,500	5,557,544	+416,956	11,350,167	10,889,841	+460,326
	106,353,595	86,167,969	+20,185,626	169,567,593	142,410,456	+27,157,137

TRANSPORTATION

The quantity and proportion of cement shipped by each of the major methods of transportation for the 1944–46 period are given in the following table. The proportions shipped by railroad, truck, and boat in 1946 were essentially the same as in 1944 and 1945. Railroads carried most of the shipments, accounting for 81 percent of the total.

Although the quantity of cement shipped in bulk and in cloth and paper bags increased in 1946 over the previous year's total, the per-

centage moved in each of these various types of containers changed little. Bulk shipments were essentially the same, cloth bags continued their steady decline, and paper bags showed a slight increase.

Shipments of portland cement from mills in the United States (including Puerto Rico), 1944–46, in bulk and in containers, by types of carriers

[Barrels of 376 pounds]

Type of carrier	In bulk		In containers				Total shipments	
			Bags		Other containers [1]	Total		
			Paper	Cloth				
1944	*Barrels*	*Percent*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Barrels*	*Percent*
Truck	[2] 5,602,744	17.2	7,230,578	2,814,618	-------	10,045,196	15,647,940	16.6
Railroad	25,279,796	77.7	35,041,534	15,257,760	9,207	50,308,501	75,588,297	80.2
Boat	1,648,229	5.1	1,273,520	113,895	-------	1,387,415	3,035,644	3.2
	32,530,769	100.0	43,545,632	18,186,273	9,207	61,741,112	94,271,881	100.0
Percent of total	34.5	-------	46.2	19.3	[3]	65.5	100.0	-------
1945 [4]								
Truck	[2] 6,131,239	19.2	9,185,986	2,688,601	-------	11,874,587	18,005,826	16.9
Railroad	24,407,302	76.4	44,831,347	15,650,807	21,954	60,504,108	84,911,410	79.9
Boat	1,391,294	4.4	1,916,118	128,947	-------	2,045,065	3,436,359	3.2
	31,929,835	100.0	55,933,451	18,468,355	21,954	74,423,760	106,353,595	100.0
Percent of total	30.0	-------	52.6	17.4	[3]	70.0	100.0	-------
1946 [4]								
Truck	[2] 10,466,492	20.7	14,987,432	3,830,531	-------	18,817,963	29,284,455	17.3
Railroad	38,586,917	76.3	75,889,354	22,996,350	13,967	98,899,671	137,486,588	81.1
Boat	1,521,447	3.0	1,142,487	132,616	-------	1,275,103	2,796,550	1.6
	50,574,856	100.0	92,019,273	26,959,497	13,967	118,992,737	169,567,593	100.0
Percent of total	29.8	-------	54.3	15.9	[3]	70.2	100.0	-------

[1] Includes steel drums and iron and wood barrels.
[2] Includes cement used at mills by producers as follows—1944: 112,593 barrels; 1945: 217,968 barrels; 1946: 584,224 barrels.
[3] Less than 0.05 percent.
[4] Includes mill in Hawaii; product shipped in paper bags by truck and railroad in 1945 and by truck only in 1946.

MILL VALUES

The average net mill realization of all portland cement shipped from mills in 1946 advanced to $1.72 per barrel from $1.63 in 1945. This gain is attributed largely to increases in ceiling prices granted in areas to which reference has been made on a preceding page.

The composite wholesale price of portland cement, f. o. b. destination, according to the Bureau of Labor Statistics index (1926=100), was 104.1 in 1946; in 1945 it was 99.4.

Average mill value per barrel, in bulk, of portland cement in the United States, 1942–46

1942	$1.53	1945	$1.63
1943	1.57	1946	1.72
1944	1.59		

CAPACITY OF PLANTS

The aggregate annual capacity of all portland-cement plants in 1946 was essentially the same as reported in 1945.

The over-all rate of operation in 1946 was at 68 percent of total capacity. As shown in the following table, the percentage of capacity utilized gained in all districts. The increases in percentage points ranged from 12 in the Virginia-Georgia-Florida-Louisiana district, to 38 in Kansas. The percentage of capacity used in each month of 1946 was higher than in the corresponding months of 1945 and—with the exception of a slight drop in May—followed the normal seasonal trend of low rates in January, February, and March and a steady increase to a peak in September, with a decline through the last quarter.

Portland-cement-manufacturing capacity of the United States, 1945–46, by producing districts

District	Estimated capacity (barrels)		Percent of capacity utilized	
	1945	1946	1945	1946
Eastern Pennsylvania and Maryland	42,567,325	42,537,325	34.1	62.3
New York and Maine	17,171,715	17,051,715	32.7	66.9
Ohio	12,191,515	12,191,515	37.8	65.9
Western Pennsylvania and West Virginia	13,651,300	13,751,300	22.7	49.0
Michigan	13,598,920	12,881,605	42.9	75.3
Illinois	9,864,510	9,864,510	44.3	63.6
Indiana, Kentucky, and Wisconsin	17,264,000	17,264,000	36.1	61.2
Alabama	9,420,810	10,403,106	58.8	75.9
Tennessee	7,417,000	7,417,000	38.9	69.4
Virginia, Georgia, Florida, and Louisiana	7,580,000	7,580,000	62.6	74.6
Iowa	7,930,000	7,930,000	40.3	69.5
Eastern Missouri, Minnesota, and South Dakota	11,129,295	11,148,795	34.7	68.5
Kansas	9,215,000	9,115,000	32.6	70.3
Western Missouri, Nebraska, Oklahoma, and Arkansas	7,550,000	7,446,000	46.0	76.6
Texas	14,080,000	14,080,000	57.1	76.1
Colorado, Wyoming, Montana, Utah, and Idaho	5,465,000	5,065,000	55.3	80.7
California	26,490,000	26,790,000	60.2	72.9
Oregon and Washington	7,350,000	7,300,000	45.9	64.5
Puerto Rico	1,620,000	1,730,000	89.0	100.0
Hawaii	75,000	75,000	29.4	50.7
	241,631,390	241,621,871	42.5	67.9

Percent of capacity used in the finished portland-cement industry in the United States, 1945–46

Month	Monthly		12 months ended—		Month	Monthly		12 months ended—	
	1945	1946	1945	1946		1945	1946	1945	1946
January	31	47	37	44	July	45	75	39	56
February	29	50	37	46	August	49	79	40	59
March	31	55	38	48	September	50	83	40	62
April	36	64	38	50	October	55	81	41	64
May	40	59	39	51	November	54	78	42	66
June	45	73	39	54	December	48	71	43	68

Total capacity of wet-process mills, as shown in the accompanying table, increased slightly each year in the 1944–46 period, in contrast to dry-process plants whose capacity declined. The percentage of total cement produced by the wet-process mills during this period, however, has declined somewhat.

A grouping of the cement plants based on their estimated annual capacity is shown in the following table.

Distribution of portland-cement plants in the United States in 1946, according to annual capacity

Estimated annual capacity, barrels:	*Number of plants*
Less than 1,000,000	37
1,000,000 to 1,999,000	85
2,000,000 to 2,999,000	21
2,999,000 to 10,000,000	11
	154

Capacity of portland-cement plants in the United States,[1] 1944–46, by processes

Process	Capacity						Percent of capacity utilized			Percent of total finished cement produced		
	Thousands of barrels			Percent of total								
	1944	1945	1946	1944	1945	1946	1944	1945	1946	1944	1945	1946
Wet	123,637	124,688	125,227	51.4	51.6	51.8	42.2	45.9	70.2	57.4	55.6	53.6
Dry	116,895	116,943	116,395	48.6	48.4	48.2	33.1	39.0	65.4	42.6	44.4	46.4
	240,532	241,631	241,622	100.0	100.0	100.0	37.8	42.5	67.9	100.0	100.0	100.0

[1] Includes Puerto Rico and Hawaii.

CLINKER PRODUCTION

The production of clinker, the intermediate product of the industry, was 61 percent greater in 1946 than in 1945. Peak production was reached in October, and stocks reached their peak in March. Stocks on December 31, 1946, were 13 percent below those reported for December 1945.

Production and stocks of portland-cement clinker at mills in the United States in 1946, by months and districts, in thousands of barrels

District	January	February	March	April	May	June	July	August	September	October	November	December
PRODUCTION												
Eastern Pennsylvania and Maryland	1,766	1,574	1,937	1,932	1,628	2,371	2,470	2,649	2,607	2,798	2,674	2,570
New York and Maine	476	541	712	882	799	977	1,052	1,173	1,158	1,154	1,208	1,115
Ohio	530	543	645	669	591	640	742	799	802	808	780	653
Western Pennsylvania and West Virginia	377	281	365	379	500	557	717	752	720	756	757	595
Michigan	660	594	451	825	728	884	922	1,058	1,010	1,044	918	832
Illinois	439	470	516	403	132	523	638	652	696	711	589	608
Indiana, Kentucky, and Wisconsin	690	547	824	808	682	902	955	1,040	1,038	1,089	1,042	940
Alabama	523	493	621	610	555	703	731	725	704	754	719	701
Tennessee	226	169	372	384	156	440	616	560	558	552	546	578
Virginia, Georgia, Florida, and Louisiana	409	379	495	529	387	526	538	570	542	449	438	509
Iowa	387	395	350	384	408	418	452	505	476	526	486	508
Eastern Missouri, Minnesota, and South Dakota	544	401	572	575	505	698	748	679	738	743	672	687
Kansas	303	354	418	469	575	616	584	601	605	667	631	643
Western Missouri, Nebraska, Oklahoma, and Arkansas	389	373	423	474	551	505	510	506	532	546	496	476
Texas	846	753	980	933	798	994	983	1,003	1,026	790	753	968
Colorado, Wyoming, Montana, Utah, and Idaho	241	194	239	323	374	354	379	406	395	409	354	360
California	1,327	1,331	1,598	1,533	1,644	1,697	1,685	1,765	1,722	1,829	1,763	1,783
Oregon and Washington	268	220	363	393	272	408	518	518	507	490	372	369
Puerto Rico	138	135	149	144	133	134	159	140	124	121	156	147
Hawaii	2	2	6	3	6	6	4	3		4	2	1
United States: 1946	10,541	9,749	12,031	12,652	11,424	14,453	15,403	16,104	15,960	16,240	15,356	15,043
1945	6,803	5,655	6,551	6,946	7,988	8,416	8,876	9,743	9,912	10,687	10,764	10,363
STOCKS (END OF MONTH)												
Eastern Pennsylvania and Maryland	725	790	851	726	638	763	783	768	661	691	775	865
New York and Maine	357	377	375	376	357	259	304	317	225	223	227	215
Ohio	171	309	316	359	332	269	260	229	183	154	191	214
Western Pennsylvania and West Virginia	218	260	288	183	137	185	212	284	245	254	259	231
Michigan	371	421	588	806	668	564	443	415	365	308	217	305
Illinois	128	146	214	193	76	132	154	133	55	19	18	79
Indiana, Kentucky, and Wisconsin	461	323	525	372	376	379	337	222	236	170	148	200
Alabama	148	121	135	123	121	173	175	140	129	142	141	133
Tennessee	250	198	178	181	71	96	132	128	100	83	85	83
Virginia, Georgia, Florida, and Louisiana	99	96	105	110	80	82	83	80	86	64	79	77
Iowa	339	373	369	394	432	378	292	234	88	32	34	131
Eastern Missouri, Minnesota, and South Dakota	426	545	636	651	519	390	322	299	253	154	129	177
Kansas	72	130	108	73	109	85	99	85	108	62	60	65
Western Missouri, Nebraska, Oklahoma, and Arkansas	94	133	168	188	253	273	283	250	212	196	130	87
Texas	216	212	174	214	104	105	90	102	104	116	109	84
Colorado, Wyoming, Montana, Utah, and Idaho	134	218	212	176	135	106	91	91	85	68	66	51
California	877	929	778	623	522	506	504	584	582	659	606	648
Oregon and Washington	176	147	211	173	140	114	134	161	143	167	190	187
Puerto Rico	41	44	47	42	37	66	84	50	35	32	44	38
Hawaii	1	2	3	1	4	3	6	8	3	4	4	4
United States: 1946	5,304	5,774	6,281	5,964	5,111	4,928	4,788	4,580	3,898	3,598	3,512	[1] 3,874
1945	5,739	6,023	6,185	6,012	5,834	5,273	4,808	4,556	4,572	4,109	4,022	[2] 4,463

[1] Subject to revision.

[2] Revised figure.

Portland-cement clinker produced and in stock at mills in the United States, 1945–46, by processes, in barrels of 376 pounds [1]

Process	Plants		Production		Stocks on Dec. 31	
	1945	1946	1945	1946	1945 [2]	1946 [3]
Wet	82	86	56,827,740	86,848,784	2,149,203	1,477,041
Dry	58	64	45,875,236	78,277,619	2,313,430	2,396,699
	140	150	102,702,976	165,126,403	4,462,633	3,873,740

[1] Compiled from monthly estimates of the producers.
[2] Revised figures.
[3] Subject to revision.

PRODUCTION ACCORDING TO RAW MATERIALS

The predominant raw materials for making portland cement in the United States since 1908, as shown in the following table, have been limestone and clay or shale. In 1946, 68 percent of the output was made from this combination compared with 71 percent in 1945. Cement rock and pure limestone, which before 1908 was the leading raw material, is now of secondary importance and supplied 24 percent of the raw materials in 1946 compared with 20 percent in 1945. Marl and clay, which was used in substantial quantities before 1906, declined thereafter and supplied only 2 percent of the raw material utilized by the cement industry in 1946. The combination of blast-furnace slag and limestone supplied 6 percent of the output in 1946 compared with 7 percent in 1945.

Production and percentage of total output of portland cement in the United States, 1898–1914, 1926, 1929, 1933, 1935, and 1941–46, according to raw materials

Year	Cement rock and pure limestone		Limestone and clay or shale [1]		Marl and clay		Blast-furnace slag and limestone	
	Barrels	Percent	Barrels	Percent	Barrels	Percent	Barrels	Percent
1898	2,764,694	74.9	365,408	9.9	562,092	15.2		
1899	4,010,132	70.9	546,200	9.7	1,095,934	19.4		
1900	5,960,739	70.3	1,034,041	12.2	1,454,797	17.1	32,443	0.4
1901	8,503,500	66.9	2,042,209	16.1	2,001,200	15.7	164,316	1.3
1902	10,953,178	63.6	3,738,303	21.7	2,220,453	12.9	318,710	1.8
1903	12,493,694	55.9	6,333,403	28.3	3,052,946	13.7	462,930	2.1
1904	15,173,391	57.2	7,526,323	28.4	3,332,873	12.6	473,294	1.8
1905	18,454,902	52.4	11,172,389	31.7	3,884,178	11.0	1,735,343	4.9
1906	23,896,951	51.4	16,532,212	35.6	3,958,201	8.5	2,076,000	4.5
1907	25,859,095	53.0	17,190,697	35.2	3,606,598	7.4	2,129,000	4.4
1908	20,678,693	40.6	23,047,707	45.0	2,811,212	5.5	4,535,300	8.9
1909	24,274,047	37.3	32,219,365	49.6	2,711,219	4.2	5,786,800	8.9
1910	26,520,911	34.6	39,720,320	51.9	3,307,220	4.3	7,001,500	9.2
1911	26,812,129	34.1	40,665,332	51.8	3,314,176	4.2	7,737,000	9.9
1912	24,712,780	30.0	44,607,776	54.1	2,467,368	3.0	10,650,172	12.9
1913	29,333,490	31.8	47,831,863	51.9	3,734,778	4.1	11,197,000	12.2
1914	24,907,047	28.2	50,168,813	56.9	4,038,310	4.6	9,116,000	10.3
1926	44,090,657	26.8	101,637,866	61.8	3,324,408	2.0	15,477,239	9.4
1929	51,077,034	29.9	97,623,502	57.2	4,832,700	2.9	17,112,800	10.0
1933	14,135,171	22.3	43,638,023	68.7	1,402,744	2.2	4,297,251	6.8
1935	23,811,687	31.0	45,073,144	58.8	1,478,569	1.9	6,378,170	8.3
1941	46,534,193	28.4	102,285,699	62.3	3,142,021	1.9	12,068,646	7.4
1942	49,479,304	27.0	115,948,373	63.4	3,009,562	1.7	14,343,945	7.9
1943	29,915,157	22.4	92,310,018	69.2	2,300,636	1.7	8,897,977	6.7
1944	17,609,055	19.4	65,478,178	72.0	2,078,530	2.3	5,739,933	6.3
1945	20,383,505	19.8	73,409,831	71.4	2,035,236	2.0	6,976,312	6.8
1946	39,070,643	23.8	112,142,154	68.4	2,720,500	1.7	10,130,891	6.2

[1] Includes output of 2 plants using oystershells and clay in 1926; 3 plants in 1929, 1933, and 1935; 4 plants in 1941–45; and 5 plants in 1946.

RAW MATERIALS

The tonnages of raw materials (exclusive of fuels and explosives) required for the production of portland cement during recent years are given in the following table. Limestone, cement rock, and clay and shale make up 93 percent of the total materials consumed. All types of raw material consumed showed large increases in 1946 over the previous year's totals.

Raw materials used in producing portland cement in the United States, 1944–46

Raw material	1944	1945	1946
	Short tons	*Short tons*	*Short tons*
Cement rock	5,119,318	5,656,390	10,781,078
Limestone [1]	19,958,151	22,747,654	34,579,673
Marl	643,412	646,391	860,798
Clay and shale [2]	2,822,881	3,162,458	4,845,224
Blast-furnace slag	278,998	380,970	706,986
Gypsum	597,297	683,158	1,157,324
Sand and sandstone [3]	230,288	272,077	460,910
Iron materials [4]	123,079	128,312	218,634
Miscellaneous [5]	22,442	36,100	144,139
Total	29,795,866	33,713,510	53,754,766
Average total weight required per barrel (376 pounds) of finished cement	*Pounds* 656	*Pounds* 656	*Pounds* 655

[1] Includes oystershells.
[2] Includes bentonite, diatomaceous shale, fuller's earth, and other clays.
[3] Includes silica and quartz.
[4] Includes iron ore, pyrite cinders and ore, and mill scale.
[5] Includes diatomite, fluorspar, pumicite, flue dust, pitch, red mud and rock, hydrated lime, tufa, cinders, calcium chloride, sludge, grinding aids, and air-entraining compound.

FUELS AND POWER

In accordance with the increased output of cement in 1946, consumption of all types of fuel increased. The annual consumption of coal in 1946 increased 67 percent over that reported in 1945; fuel oil and natural gas showed gains of 31 and 48 percent, respectively; and byproduct gas a gain of 153 percent. The large increase in byproduct gas is due to the fact that this type of fuel was not used in cement plants before April 1945. Thus, 1946 represents the first year for which a 12 months' total is available.

Coal stocks in October and November reached the million-ton mark for the first time since July 1942. Although this represents a peak tonnage, the stocks were only sufficient for 1½ months' supply at the October-November rate of production.

As shown in an accompanying table, the number of portland-cement plants using electric energy in the production of cement and the quantity of this energy consumed increased in 1946 over the 1945 total. The percentage of electricity generated also increased, and the quantity purchased declined.

Finished portland cement produced and fuel consumed by the portland-cement industry in the United States, 1945–46, by processes

Process	Finished cement produced			Fuel consumed [1]		
	Plants	Barrels of 376 pounds	Percent of total	Coal (short tons)	Oil (barrels of 42 gallons)	Natural gas (M cubic feet)
1945						
Wet	81	57,192,688	55.6	2,126,895	1,828,788	26,340,213
Dry	60	45,612,196	44.4	2,078,329	1,215,738	12,833,720
	141	102,804,884	100.0	[2] 4,205,224	3,044,526	39,173,933
1946						
Wet	87	87,090,889	53.1	3,503,921	2,348,759	35,171,680
Dry	65	76,973,299	46.9	3,504,809	1,637,662	22,832,429
	152	164,064,188	100.0	[3] 7,008,730	3,986,421	58,004,109

[1] Figures compiled from monthly estimates of the producers.
[2] Includes 12,004 tons of anthracite and 4,193,220 tons of bituminous coal.
[3] Includes 19,120 tons of anthracite and 6,989,610 tons of bituminous coal.

Portland cement produced in the United States, 1945–46, by kinds of fuel

Fuel	Finished cement produced			Fuel consumed [1]		
	Number of plants	Barrels of 376 pounds	Percent of total	Coal (short tons)	Oil (barrels of 42 gallons)	Natural gas (M cubic feet)
1945						
Coal	84	[2] 54,864,433	53.3	3,481,492		
Oil	13	[2] 9,739,804	9.5		1,988,197	
Natural gas	12	[2] 9,440,052	9.2			13,413,573
Coal and oil	9	9,217,452	9.0	563,467	498,504	
Coal and natural gas	15	8,081,634	7.9	158,132		[3] 11,889,766
Oil and natural gas	5	9,575,071	9.3		528,107	10,991,059
Coal, oil, and natural gas	3	1,886,438	1.8	2,133	29,718	2,879,535
	141	102,804,884	100.0	[4] 4,205,224	3,044,526	39,173,933
1946						
Coal	91	[2] 92,469,773	56.3	5,746,785		
Oil	13	[2] 12,615,568	7.7		2,583,183	
Natural gas	12	[2] 11,762,138	7.2			17,397,628
Coal and oil	10	14,566,471	8.9	883,015	554,919	
Coal and natural gas	13	13,281,081	8.1	359,160		[5] 16,025,258
Oil and natural gas	7	13,324,422	8.1		764,048	15,034,902
Coal, oil, and natural gas	6	6,044,735	3.7	19,770	84,271	9,546,321
	152	164,064,188	100.0	[6] 7,008,730	3,986,421	58,004,109

[1] Figures compiled from monthly estimates of the producers.
[2] Average consumption of fuel per barrel of cement produced was as follows: 1945—Coal, 126.9 pounds; oil, 0.2041 barrel; natural gas, 1,421 cubic feet. 1946—Coal, 124.3 pounds; oil, 0.2048 barrel; natural gas, 1,479 cubic feet.
[3] Includes 824,665 M cu. ft. of byproduct gas.
[4] Includes 12,004 tons of anthracite and 4,193,220 tons of bituminous coal.
[5] Includes 2,090,100 M cu. ft. of byproduct gas.
[6] Includes 19,120 tons of anthracite, and 6,989,610 tons of bituminous coal.

Electric energy used at portland-cement-producing plants in the United States, 1945–46, by processes, in kilowatt-hours

Process	Electric energy used						Finished cement produced (barrels)	Average electric energy used per barrel of cement produced (kilowatt-hours)
	Generated at portland-cement plants		Purchased		Total			
	Active plants	Kilowatt-hours	Active plants	Kilowatt-hours	Kilowatt-hours	Percent		
1945								
Wet	30	463,905,324	72	889,558,105	1,353,463,429	53.9	57,192,688	23.7
Dry	30	654,943,970	49	503,676,105	1,158,620,075	46.1	45,612,196	25.4
	60	1,118,849,294	121	1,393,234,210	2,512,083,504	100.0	102,804,884	24.4
Percent of total electric energy used		44.5		55.5	100.0			
1946								
Wet	31	692,119,678	75	1,287,115,691	1,979,235,369	51.2	87,990,049	22.5
Dry	34	1,193,871,747	52	691,336,772	1,885,208,519	48.8	76,074,139	24.8
	65	1,885,991,425	127	1,978,452,463	3,864,443,888	100.0	164,064,188	23.6
Percent of total electric energy used		48.8		51.2	100.0			

TYPES OF CEMENT

A break-down of total production of portland cement by various types for the 1942–46 period is given in the following table. The output of all types increased in 1946 over that reported in the previous year. The quantity of air-entrained cement produced and shipped, first reported separately to the Bureau of Mines in 1945, is also shown in the table. The increase in 1946 output over the 1945 figure is more apparent than real, because some producers did not keep separate statistics on the quantities of this type of cement produced in 1945. The large increase in sales of sulfate-resisting, type V, and portland-puzzolan is noteworthy.

Prepared Masonry Mortars.—Production of these mixed materials in 1946 was reported by 82 plants and totaled 8,596,244 barrels. Shipments reached 8,632,601 barrels, valued at $15,729,380, an average mill realization of $1.82 per barrel. These data are not included in the statistical tabulations in this chapter, but the portland cement used in producing the mixtures is included.

Portland cement produced and shipped in the United States, 1942–46, by types

Kind and year	Active plants	Production (barrels)	Shipments		
			Barrels	Value	
				Total	Average
General use and moderate heat (types I and II):					
1943 [1]	153	123,490,667	118,347,297	$182,682,614	$1.54
1944 [2]	151	83,576,685	86,933,387	135,564,313	1.56
1945 [3]	145	89,922,894	93,379,480	148,653,647	1.59
1946 [3]	153	139,355,317	144,212,386	244,331,033	1.69
High-early-strength (type III):					
1942	87	7,523,647	7,065,700	13,683,665	1.94
1943	95	6,816,671	6,299,190	12,040,467	1.91
1944	97	5,135,264	5,190,092	10,278,215	1.98
1945	103	5,487,460	5,602,875	11,280,392	2.01
1946	111	6,716,488	7,183,209	14,977,117	2.09

See footnotes at end of table.

Portland cement produced and shipped in the United States, 1942–46, by types—Continued

Kind and year	Active plants	Production (barrels)	Shipments		
			Barrels	Value	
				Total	Average
Low-heat (type IV):					
1943 [1]	4	1,710,617	1,687,277	2,316,755	1.37
1944	4	441,368	400,998	554,684	1.38
1945	3	35,715	30,840	50,358	1.63
1946	3	139,996	136,541	248,057	1.82
Sulfate-resisting (type V):					
1942	8	79,835	77,015	136,939	1.78
1943	5	24,419	20,697	40,933	1.98
1944	4	100	1,647	3,280	1.99
1945	4	5,141	3,915	7,952	2.03
1946	4	65,880	60,950	125,204	2.05
Oil-well:					
1942	17	537,541	552,157	1,100,296	1.99
1943	16	630,412	544,436	1,050,178	1.93
1944	15	938,872	931,371	1,802,361	1.94
1945	16	1,231,756	1,305,493	2,490,739	1.91
1946	17	1,329,462	1,394,999	2,827,825	2.03
White:					
1942	5	345,613	306,120	1,214,422	3.97
1943	6	318,470	335,110	1,340,201	4.00
1944	6	302,543	322,443	1,303,440	4.04
1945	5	425,299	456,210	1,859,070	4.08
1946	5	774,215	797,194	3,299,299	4.14
Portland-puzzolan:					
1942	7	324,002	329,637	465,627	1.41
1943	4	215,026	221,182	311,230	1.41
1944	4	290,013	244,858	337,250	1.38
1945	3	212,156	250,944	389,482	1.55
1946	5	1,092,607	1,091,854	1,696,370	1.55
Air-entrained:					
1945 [2]	52	5,075,332	4,903,355	7,773,719	1.59
1946	69	13,765,384	13,850,982	23,173,284	1.67
Miscellaneous: [3]					
1942	12	242,170	269,705	468,033	1.74
1943	23	217,506	176,670	320,838	1.82
1944	21	220,851	247,085	514,211	2.08
1945	11	409,131	420,483	822,651	1.96
1946	21	824,839	839,478	1,714,743	2.04

[1] Figures reported separately for the first time in 1943.
[2] Includes air-entrained and Vinsol resin cements classed as modified cements by producers.
[3] Includes Hawaii.
[4] Figures reported separately for the first time in 1945.
[5] 1942: Includes hydroplastic portland cements; 1943–46: Includes hydroplastic, plastic, and waterproofed cements.

TECHNOLOGIC DEVELOPMENTS

Blast-furnace cement, now being produced in the United States, consists of a mixture of not less than 30 percent clinker and not more than 65 percent of properly granulated slag. This should not be confused with the inferior slag cements made during the 1914–18 period—from granulated slag, hydrated lime, and an alkali or sulfate accelerator—which were irregular and unreliable and are no longer manufactured. The Germans, French, Belgians, and Japanese have been producing blast-furnace cements for some time. The product can be produced at a lower cost than can standard portland cement, and as it can be utilized for many uses for which portland cement is now specified, it seems probable that the market for this type cement in the United States may increase.

Several types of mass-production masonry houses utilizing cement were reported in 1946. The R. G. Le Tourneau Co. has developed a machine that lays a 24- by 30-foot concrete house. The Peerless Construction Co. of New York City casts walls, with provisions for

doors and other openings, of high-early-strength concrete in light-gage steel decking, spanning curved strut rockers; the rockers are positioned on the basement floor so that the walls, when hardened, swing into an upright position by gravity.

Federal and American Society for Testing Materials specifications for cement were revised during 1946, setting limitations on chemical composition that serve to increase control measures on proportioning raw materials and their flow through grinding mills, storage silos, and kilns. General acceptance of air entrainment, as improving the quality of concrete for some uses, is increasing and the United States Public Roads Administration has approved three such admixtures in its highway specifications.

A new process of manufacturing cement includes improvements which comprise reducing the raw materials used in manufacturing cement to a fine powder so that at least 90 percent will pass 100-mesh and blowing the powder continuously with enough gas to maintain the powder in a fluid condition. The temperature of the fluid is raised progressively by passing a heating gas in countercurrent flow to the fluidized powder at a velocity adjusted to maintain the powder in the form of a dense turbulent body. The dense materials are maintained in contact with heating gas long enough to drive off first the moisture, then the carbon dioxide, and finally to clinker the finely divided material. This process is covered by United States Patent 2,409,707, October 22, 1946.

It is also reported that the English have successfully used anhydrite in the manufacture of cement clinker and sulfuric acid. Anhydrite is substituted for limestone in the kiln feed, and carbon in the form of coke is used as the reducing agent. The sulfate is reduced to a sulfite, and lime is released. The sulfur dioxide formed is drawn off under suction and utilized in the manufacture of sulfuric acid.[3]

NATURAL, MASONRY (NATURAL), AND PUZZOLAN CEMENTS

Nine cement plants in 1946, as in the previous year, produced hydraulic cements other than portland. Output and shipments in 1946, however, were, respectively, 67 and 71 percent greater, and stocks were 34 percent lower than in 1945. Producers reported a consumption of 32,273 short tons of coal and of gas equivalent to approximately 2,167 short tons of coal.

Natural, masonry (natural), and puzzolan (slag-lime) cements produced, shipped, and in stock at mills in the United States, 1942–46

Year	Production		Shipments		Stocks on Dec. 31
	Active plants	Barrels (376 pounds)	Barrels (376 pounds)	Value	Barrels (376 pounds)
1942	11	2,560,425	2,508,324	$3,668,169	253,307
1943	10	1,830,266	1,846,803	2,357,112	227,152
1944	9	1,246,703	1,320,274	1,638,892	166,889
1945	9	1,483,763	1,479,513	2,093,848	[1] 170,324
1946	9	2,474,674	2,533,106	4,155,171	[2] 111,892

[1] Revised figure. [2] Subject to revision.

[3] Chemical Age (London), Sulphuric Acid and Cement Plant: Vol. 55, No. 1432, Dec. 7, 1946, p. 698.

FOREIGN TRADE[3]

Imports.—As shown in the following table, imports of cement have been small during recent years and for the most part represent purchases from Canada. Imports of all hydraulic cements except white nonstaining portland cement, 1944–46, are listed by country of origin in the second following table. Imports of white nonstaining cement in 1946 totaled 139 barrels valued at $468.

Hydraulic cement imported for consumption in the United States, 1942–46

Year	Barrels	Value	Year	Barrels	Value
1942	644	$2,020	1945	323	$700
1943	13,658	55,560	1946	3,734	15,531
1944	169	418			

Roman, portland, and other hydraulic cements imported for consumption in the United States, 1944–46, by countries[1]

Country	1944		1945		1946	
	Barrels	Value	Barrels	Value	Barrels	Value
Belgium and Luxembourg					2	$4
Canada	169	$417	320	$685	2,498	8,124
Chile			(2)	2		
Dominican Republic			3	13		
Guatemala	(2)	1				
United Kingdom					1,091	6,922
	169	418	323	700	3,591	15,050

[1] Excludes "white, nonstaining, and other special cement."
[2] Less than 1 barrel.

Exports.—Exports of slightly more than 5 million barrels of cement to foreign countries in 1946, although less than the previous year's figure, was still far greater than the average prewar total. As shown in an accompanying table, shipments to Venezuela, Mexico, and Brazil accounted for 55 percent of total exports. The quantities shipped to these countries were, respectively, 21, 20, and 14 percent of the total. Substantial quantities were also exported to the Dominican Republic, Canada, Colombia, and Cuba.

Hydraulic cement exported from the United States, 1942–46

Year	Barrels	Value	Percent of total shipments from mills
1942	1,100,826	$2,707,217	0.6
1943	1,731,956	4,654,862	1.3
1944	4,040,405	10,044,838	4.2
1945	6,476,333	15,570,610	6.0
1946	5,163,362	13,484,933	3.0

[3] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Hydraulic cement exported from the United States, 1944–46, by countries

Country	1944		1945		1946	
	Barrels	Value	Barrels	Value	Barrels	Value
North America:						
Bermuda	15,503	$33,352	15,361	$41,582	10,972	$25,055
Canada	22,064	93,863	41,151	152,365	295,101	979,906
Central America:						
British Honduras	6,282	14,057	7,519	16,401	1,621	3,882
Canal Zone	75,185	155,950	87,215	182,616	75,646	178,671
Costa Rica	59,412	131,701	163,162	348,183	60,897	168,958
El Salvador	41,983	104,669	110,137	242,483	82,585	197,794
Guatemala	2,408	11,686	6,051	16,168	37,546	103,915
Honduras	37,128	91,197	56,699	131,185	40,150	90,048
Nicaragua	3,203	9,744	23,749	51,075	24,649	56,314
Panama, Republic of	249,371	577,185	380,549	836,466	151,196	383,248
Mexico	560,554	1,461,926	1,012,337	2,587,303	1,033,474	2,811,361
Newfoundland and Labrador	75	314	2,259	4,951	3,636	8,499
West Indies:						
British:						
Bahamas	19,635	50,560	17,855	45,270	14,197	42,449
Jamaica	3,107	7,349	16,471	36,249	6,105	13,540
Leeward and Windward Islands	21,838	49,837	18,269	42,112	463	1,018
Trinidad and Tobago	15,840	36,681	28,988	62,567		
Other			3,657	7,814		
Cuba	387,043	842,143	450,969	1,016,204	284,389	717,738
Curacao (N. W. I.)	82,048	181,252	116,499	257,394	49,037	128,232
Dominican Republic	233,750	550,839	229,328	497,232	323,072	730,119
French West Indies	64,376	149,874	67,430	140,082	58,412	125,588
Haiti	31,222	73,244	62,491	139,658	37,025	88,366
Other North America	2,537	7,286	14,304	30,049	25	284
	1,934,564	4,634,709	2,932,450	6,885,409	2,590,198	6,854,985
South America:						
Argentina	4,491	26,890	5,786	32,403	14,045	81,786
Bolivia	95,615	222,847	417	2,116	878	5,449
Brazil	505,554	1,421,247	1,234,255	3,074,391	735,094	1,853,186
Chile	35,446	111,946	199,770	440,097	7,509	32,558
Colombia	223,866	527,138	185,187	531,599	286,660	796,790
Ecuador	10,498	32,398	8,521	21,663	35,652	85,329
Paraguay	775	3,152	2,165	6,471	7,804	21,200
Peru	20,868	54,913	54,937	141,092	70,732	188,398
Surinam	29,031	61,213	18,125	40,918	3,250	6,975
Uruguay	2,278	12,251	6,158	30,536	3,024	21,176
Venezuela	1,075,596	2,676,180	1,444,699	3,441,990	1,066,317	2,590,675
Other South America	21,360	47,844	4,697	10,691	4,701	10,974
	2,025,378	5,198,019	3,164,717	7,773,967	2,235,666	5,694,496
Europe:						
France			157,181	352,998		
Norway			8,843	18,215	121	12,255
Portugal	253	1,412	1,082	6,478	434	2,552
Other Europe	104	152	1,140	9,410	639	5,651
	357	1,564	168,246	387,101	1,194	20,458
Asia:						
Arabian Peninsular States	19,793	53,747	6,934	21,166	32,067	77,345
Bahrein, State of	4,480	16,886	274	1,453	301	2,895
China			500	1,080	156,252	424,987
French Indochina			23,400	53,352	88	543
Hong Kong					18,073	39,559
Iran	42,560	102,518	9	159	165	899
Netherlands Indies			6,681	14,404	1,000	2,325
Palestine and Trans-Jordan	122	1,675	9	83		
Philippines, Republic of			90,048	211,414	93,819	261,954
Other Asia	241	852	14,449	37,077	5,753	23,468
	67,196	175,678	142,304	340,188	307,518	833,975
Africa:						
Egypt	200	1,100			250	785
Liberia	8,487	18,257	4,788	15,807	5,014	11,197
Mozambique			14,507	40,005	300	957
Portuguese Guinea and Angola	2,514	5,580	44,468	99,035	13,938	38,919
Tangier			500	1,500	3,247	7,077
Union of South Africa	292	1,760	1,439	9,209	5,031	19,758
Other Africa	827	6,944	2,202	11,681	943	2,156
	12,320	33,641	67,904	177,237	28,723	80,849

Hydraulic cement exported from the United States, 1944–46, by countries—Con.

Country	1944		1945		1946	
	Barrels	Value	Barrels	Value	Barrels	Value
Oceania:						
Australia			587	$5,500		
French Pacific islands	590	$1,227			63	$170
New Zealand			120	1,184		
Other Oceania			5	24		
	590	1,227	712	6,708	63	170
	4,040,405	10,044,838	6,476,333	15,570,610	5,163,362	13,484,933

Shipments of hydraulic cements to noncontiguous Territories of the United States, 1944–46, are shown in the following table. With the exception of the Virgin Islands, which showed a slight decrease in 1945, the trend in shipments to all of the Territories during the 1944–46 period has been upward. The upswing in 1946 was particularly sharp.

Hydraulic cement shipped to noncontiguous Territories of the United States, 1944–46

Territory	1944		1945		1946	
	Barrels	Value	Barrels	Value	Barrels	Value
Alaska	27,832	$79,589	40,599	$113,430	43,929	$124,259
American Samoa	27	59	83	232	304	919
Hawaii	111,878	239,079	208,394	405,208	469,565	865,444
Puerto Rico	2,583	15,123	5,271	28,661	41,762	109,682
Virgin Islands	20,774	69,565	19,082	48,663	25,964	66,088

WORLD REVIEW

Figures on the output of cement in many of the cement-producing countries of the world have again become available, and it is believed that a reasonable estimate of world production can again be made. Available statistics on world production in the 1941–46 period are given in the following table.

World production of hydraulic cements, 1941–46, by countries, in metric tons [1]

[Compiled by P. Roberts]

Country	1941	1942	1943	1944	1945	1946
North America:						
Canada	1,328,587	1,448,818	1,159,286	1,141,595	1,344,934	1,812,232
Cuba	155,550	166,090	169,609	173,750	180,753	(2)
Guatemala	[3] 19,000	[3] 19,000	[3] 21,000	23,000	[3] 29,000	26,478
Mexico	537,464	588,476	578,253	[3] 662,800	[3] 900,800	[3] 1,072,500
Nicaragua		620	12,030	10,034	[3] 16,000	9,975
United States	28,466,331	31,610,471	23,067,914	15,716,820	17,786,688	28,403,616
South America:						
Argentina	1,168,881	1,076,858	957,076	1,079,974	1,087,578	1,140,529
Bolivia	24,000	22,579	22,675	27,600	27,534	30,742
Brazil	767,506	753,833	[4] 747,409	809,908	774,378	824,900
Chile	359,720	364,584	374,747	362,877	411,088	579,800
Colombia	210,912	207,793	258,578	281,626	302,730	[3] 328,000
Ecuador	17,213	19,802	27,860	34,691	37,504	38,497
Peru	167,872	188,882	206,792	248,537	264,892	260,702
Uruguay	179,066	(2)	(2)	165,990	185,290	[3] 220,000
Venezuela	115,415	121,833	111,721	119,670	124,447	128,329

See footnotes at end of table.

World production of hydraulic cements, 1941–46, by countries, in metric tons [1]—Continued

Country	1941	1942	1943	1944	1945	1946
Europe:						
Albania	[3] 14,000	[2]	[2]	[2]	[2]	[2]
Austria	842,000	682,000	773,000	[2]	[2]	[2]
Belgium	[5] 630,580	[5] 510,670	[5] 459,520	600,000	646,900	1,889,800
Bulgaria	[2]	[2]	[2]	126,044	245,100	[2]
Czechoslovakia	[6] 300,000	[6] 320,000	[6] 350,000	[2]	[2]	920,000
Denmark	421,137	434,765	639,038	646,837	219,996	501,835
Eire	294,000	202,000	251,980	222,515	[2]	[2]
Finland	307,087	178,802	238,279	180,221	277,679	[2]
France	3,405,760	2,496,620	2,926,250	1,485,560	1,500,000	[3] 3,500,000
Germany	[7] 11,349,000	[7] 7,287,000	[7] 9,073,000	[2]	[2]	[8] 2,529,000
Greece	63,000	30,000	[2]	[2]	[2]	[2]
Hungary	669,330	728,190	701,290	[9] 153,290	[10] 38,280	[2]
Italy	2,793,548	[2]	[2]	[2]	[2]	[2]
Netherlands	461,000	370,000	358,000	214,000	231,000	402,654
Norway	312,830	373,648	311,152	[2]	[2]	[2]
Poland	[2]	[2]	[2]	[2]	[11] 297,000	1,399,000
Portugal	272,000	243,600	246,799	244,974	262,980	330,100
Rumania	620,520	560,996	840,485	[2]	[2]	[2]
Spain	1,639,923	1,646,280	1,701,520	1,843,037	1,926,052	1,718,574
Sweden	645,023	823,890	922,734	1,061,140	[2]	[2]
Switzerland	711,000	439,000	367,000	430,000	415,000	644,000
U. S. S. R.	[3] 5,800,000	[2]	[2]	[2]	[2]	[2]
United Kingdom	7,257,645	7,376,523	7,081,869	4,623,188	4,116,019	6,681,545
Yugoslavia	[2]	[2]	[3] 750,000	[2]	[2]	[2]
Asia:						
China [12]	1,189,100	1,572,000	1,538,247	1,177,890	[2]	300,000
Formosa	212,280	228,107	309,394	245,000	[2]	[2]
Hong Kong	[3] 110,000	[2]	[2]	[2]	[2]	[2]
India	2,124,000	2,220,000	2,148,000	2,076,000	2,244,000	2,053,000
Indochina, French	[3] 300,000	[2]	[2]	[2]	[2]	[2]
Iran	55,000	55,000	35,000	38,000	[2]	[2]
Japan	5,828,459	4,356,023	3,767,666	2,995,053	1,194,010	929,000
Korea	1,305,984	1,181,429	1,400,000	1,003,002	[13] 139,049	[13] 10,696
Netherlands Indies	[3] 170,000	[2]	[2]	[2]	[2]	[2]
Palestine	114,841	216,577	166,804	176,499	147,237	265,935
Philippines, Republic of	184,750	[2]	[2]	[2]	[10] 27,231	56,261
Siam	[3] 117,000	[2]	[2]	[2]	[2]	[2]
Syria and Lebanon	82,410	214,800	151,900	155,000	190,000	189,000
Turkey	272,919	210,855	151,472	285,350	290,266	324,900
Africa:						
Algeria	[2]	[2]	80,900	96,445	[2]	[2]
Belgian Congo	42,586	64,340	69,221	84,776	[3] 14,000	85,314
Egypt	420,107	420,980	322,859	423,902	432,088	587,577
Eritrea	9,000	25,000	27,500	38,000	[2]	[2]
Ethiopia [3]	20,000	20,000	25,000	[2]	[2]	[2]
Morocco, French	[2]	[2]	[3] 140,000	109,020	76,900	175,191
Mozambique	27,260	24,941	30,647	27,932	33,919	26,275
Tunisia	57,200	56,300	23,000	58,500	59,600	82,550
Union of South Africa	878,000	948,000	915,600	1,113,600	1,050,000	1,180,200
Oceania:						
Australia: [14]						
New South Wales	390,171	337,947	351,887	313,976	312,185	[2]
Tasmania	85,729	53,324	43,530	[2]	42,782	[2]
Victoria	215,301	172,017	[2]	127,971	133,407	152,763
New Zealand	217,200	217,200	226,800	226,800	237,600	229,900
Total [15]	87,976,000	85,220,000	78,023,000	60,360,000	54,118,000	76,100,000

[1] Data cover all hydraulic cements.
[2] Data not available; estimate included in total.
[3] Estimate.
[4] Beginning in 1943, white cement is included.
[5] Excludes portland-cement data, which are not yet available.
[6] Slovakia only.
[7] Includes Sudetenland.
[8] Excludes Russian zone of occupation.
[9] January to June, inclusive.
[10] June to December, inclusive.
[11] April to December, inclusive.
[12] Data represent area designated as Free China during the period of Japanese occupation, and Manchuria.
[13] South Korea only.
[14] Cement is also produced in Queensland and South Australia, but data are not available.
[15] Estimated by senior author of chapter.

LATIN AMERICA

The building and construction boom which swept the United States in 1946 was also apparent in Latin America. New mills are being built or have been completed in Cuba, Ecuador, Peru, and Chile, and one is being planned in Bolivia by a Chilean firm.

Argentina.—The Republic of Argentina has 11 portland-cement plants, 3 of which also produce white cement. Because of wartime shipping difficulties, cement was not imported during 1944 and 1945. Restrictions on fuel oil were removed early in 1946; but because of the heavy backlog of orders demands were far ahead of production, and thus the import market is good. However, this condition is thought to be temporary, as the plants in existence are adequate for all requirements when fuel is available. Government-sponsored programs to construct additional plants are also being considered.

Brazil.—The cement industry in Brazil like that in Argentina has been handicapped by fuel shortages. The rated capacity of the six operating plants is 950,000 tons, but actual production has not exceeded 825,000 tons. One new plant at Belo Horizonte, with an annual capacity of 50,000 tons, was completed in 1946, and an additional kiln was added to the plant in São Paulo. Because of the fuel shortages, imports of cement in Brazil have averaged about 200,000 tons annually for the past few years. Imports are expected to remain at about this level for a few more years. The consumption of white portland cement has increased since 1942 because of its wide use in plaster facings for new buildings. Brazilian production of white portland cement started in 1943.

Chile.—Production of cement in Chile in 1946 reached 579,800 metric tons compared with 411,088 tons in 1945. In view of the plant improvements during 1946, it is expected that cement production in 1947 will continue to increase.

Mexico.—Seventeen cement plants were operating in Mexico in 1946, and 4 more are either under construction or in the planning stage. The Marquette Cement Manufacturing Co. of Chicago, Ill., is supplying designing, construction, technical, and operating services for new plants at Atoyac, near Orizaba, in the State of Veracruz and in the city of Chihuahua, State of Chihuahua. The Universal Atlas Cement Co. of New York is financially interested in a mill at Irapuato between Mexico City and Guadalajara in the State of Jalisco. The Compania de Cemento Portland S. A. at Tolteca, State of Hidalgo, has announced plans to erect a new plant, adjacent to the present operations, that will be in production by the end of 1947.

Panama.—This country has depended on the United States and South America for its supplies of cement, and under normal conditions these sources have been adequate. However, as early as 1939 effects of the impending war were becoming evident. Plans were made to erect a cement plant, and contracts for equipment were let in 1944 to an American firm, but because of priority difficulties the material did not begin to arrive until 1945. The plant is on the Quebraucha River near Chilibre, and is a wet-process plant having two 200-foot rotary kilns fired by oil. Plant capacity is to be 300 metric tons (1,760 barrels) per 24-hour day.

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Venezuela.—The Government recently granted a subsidy equivalent to $1,250,000 to the National Cement Co. to enable this new firm to erect factories. Although some cement is being made, most of it is imported from the United States. Two new plants at Maracaibo and Barquismeto are nearing completion, and it is reported that an American company will build another plant at Chichirivichi.

EUROPE

Demands for cement in the devastated countries of Europe are great, but one of the chief difficulties is that of obtaining the required quantity and quality of coal to produce the clinker. Considerable success has been obtained by successful substitution of blast-furnace slag cement, which requires less fuel than portland cement.

Belgium.—The results of experiments in fine grinding of clinker, which have been in process over a number of years in Belgium, have recently been released.[4] Using a charge filling from 30 to 40 percent of the mill volume and using 20-mm. balls followed by 25-mm. balls gives the best yield of finished cement.

Beginning with June 1945 the production of cement in Belgium increased rapidly and reached a total of 646,900 metric tons for the year.[5] Production in 1946 was 1,889,800 metric tons, and Belgium reentered the export market, shipping cement to Latin America.

France.—A process has been invented in France to manufacture portland cement without using coal; it involves the use of the calcareous or argillaceous waste from coal mines and the soot, dross, and clinker emanating from coal combustion.[6] A supersulfated slag cement is also being produced in this country and Belgium under the trade name "Sealithor." It has good resistance to chemical agents and high mechanical strength and compressive strength comparable to high-early-strength portland cement; it is being utilized currently in the reconstruction of French and Belgian harbors.

Germany.—The dry process of raw-mix preparation predominates strongly over the wet method in this country. Raw mix, mesh sizes, were relatively coarse with the emphasis on output and low power consumption. Vertical kilns are still used in many plants, and most all finish grinding is done in open circuit. An excellent article has recently been published reviewing the cement industry in Germany.[7] The substitution of blast-furnace slag cement, made by grinding 30 to 65 percent of granulated blast-furnace slag with portland-cement clinker and a small quantity of gypsum, for straight portland at a reduction in cost has been successful in Germany. A high-early-strength cement has also been developed which can be poured with safety down to —7° C. It cannot be mixed with portland cement, however, because the heat given off in setting will break down portland cement. It is also about three times as costly as portland and thus is economical only where the special characteristic of quick strength is needed.

[4] Slegten, J. A., Belgian Experiments in Clinker Grinding: Rock Products, vol. 49, September 1946 No. 9, p. 60.
[5] Bureau of Mines, Mineral Trade Notes: Vol. 24, No. 4, April 1947, p. 22.
[6] Abs. in Journal American Ceramic Society, vol. 29, No. 3, March 1946, p. 49.
[7] Swayze, M. A., and Davis, G. G. J., What Has Happened to Cement Industry in Germany: Rock Products, vol. 49, No. 7, July 1946, pp. 74–79; No. 8, August 1946, pp. 120–127.

Spain.—Coal shortages in 1946 restricted the output of Spain's 25 cement plants and further increased the backlog of orders arising from wartime shortages and the postwar construction boom. As Spain now is reduced to using almost entirely relatively poor-grade native coals, methods have been devised to get the maximum performance from these low-grade fuels.

Sweden.—A cement and concrete research institute was opened in May 1945 in Sweden, with its principal purpose a study of the manufacture and properties of cement, the structural constitution of concrete, and ways and means to use it more rationally. The Skansha Cement Co., at Koping, has recently put into operation a new plant which features a 478-foot kiln and is manufacturing clinker by the wet process, with a heat consumption of 850,000 B. t. u. per barrel. This company's output (practically the national total) was 743,000 tons in 1945 and is expected to increase by about 160,000 tons in 1946. Plans have also been made to construct an additional plant of 320,000 tons annual capacity south of Stockholm in the near future.

Switzerland.—Large quantities of cement are required to build new hydroelectric plants and to enlarge those already in operation. The Government, therefore, released 450,000 tons of cement for such purposes. It is believed that only 70,000 tons will be available for new dwellings. Government controls on imports were released in 1946, but the relatively high prices prevailing in the surrounding countries deter foreign purchases.

U. S. S. R.—Recent exhibits of the Soviet cement industry include colored cements in white, blue, cream, light green, and pink. A new plant to be built in the Donbass (Ukraine) will feature these cements, and another new plant to be erected soon in the vicinity of Stolinsk (Kuzvetsk Basin) reportedly will make portland cement from blast-furnace slag and limestone found in the Gurevsk area. The first cement plant in the Karelo-Finnish S. S. R. is under construction at Letnyaya. Annual output will be on the order of 10,000 metric tons with production beginning near the end of 1946.

ASIA

Ceylon.—A Government cement plant is being constructed as a part of the industrialization program of Ceylon. The new plant is in the northern peninsula of the island and will have an annual capacity of 100,000 tons. The price of cement produced here is expected to compare favorably with that in India.

China.—During the 8 years of war with Japan, China was blockaded from the outside world, and as all cement plants were located in the coastal Provinces, they were under Japanese control. Inland the Chinese constructed eight new plants, but only two had rotary kilns. At the cessation of hostilities, seven of the plants under Japanese control, with a combined annual output of 4,470,000 barrels, were again available to the Chinese. However, internal troubles in China are delaying production further. A new plant is under construction at Hankow and is expected to get into production in 1947. The plant when completed will be a wet-process operation with a daily capacity of 6,000 barrels. Some of the plants in Manchuria, built by the Japanese, are expected to be made available to China, but the condi-

tion and quantity of machinery available at these plants are not known.

India.—It is believed that the potential capacity of the cement industry in India at the end of 1946 was 3,000,000 tons. Under the proposed expansion program of the present plants and the construction of new plants in Southern Bengal, Wardha, Sirmur, Gangpur, Bhapal, and Tehri Garhival, annual capacity is expected to increase at the rate of 1,150,000 tons per year for the next 5 years.

Japan.—Cement is one of the few commodities in which Japan is self-sufficient. Thirty-five plants were in operation in 1946. Portland cement is the major product although four other types are manufactured. These are high-early-strength portland, silica, blast-furnace slag and nonconstructive cements. Production in 1946 was hampered not only by the shortage of coal but further by the inability of the cement companies to obtain deliveries of coal with the necessary B. t. u. to produce good portland-cement clinker. Labor troubles in coal mines was an additional factor which restricted cement production in Japan. Silica cement, as manufactured in Japan, consists of about 70 percent portland-clinker and 30 percent volcanic ash or silicious clay, and blast-furnace slag consists of equal portions of portland-clinker and silicious slag. The advantages reported for silica cement are low-heat while setting and a very dense product after setting.

Korea.—There are seven cement plants in Korea, four of which have three rotary kilns each, and three have one kiln each. Five of the seven plants are in North Korea (north of the 38th parallel), and one of the two plants below that line obtains its raw materials in the northern part. Production of cement reported for 1946 represents the output of the plant at Sanchoku, formerly owned and operated by the Onado Cement Co. of Japan. This plant has one rotary kiln and a rated annual capacity of 150,000 metric tons. Total annual capacity of the cement industry in Korea before the recent war was 1,700,000 metric tons. This had declined to 1,200,000 tons at the cessation of hostilities in August 1945.

Chromium

By EDWIN K. JENCKES

GENERAL SUMMARY

THE outstanding feature of the domestic chromite industry in 1946 was the deficiency in supply of metallurgical-grade ore, the consumption of which totaled 125 percent of imports. The decline in availability of metallurgical-grade ore occurred in spite of the apparently satisfactory over-all statistical position of chromite, which indicated a small addition to total stocks of ore in the United States. This anomalous situation has arisen because imports of chemical- and refractory-grade chromite have exceeded current consumption.

Salient statistics of chromite in the United States, 1945–46

	1945		1946	
	Short tons	Value	Short tons	Value
New supply:				
Domestic production (shipments)	13,973	$532,382	4,107	$105,041
Imports for consumption	914,765	17,530,293	757,391	11,459,121
Total	928,738	18,062,675	761,498	11,564,162
Distribution:				
Consumption by industry	808,120	(1)	734,759	(1)
Exports	12,366	342,114	2,158	80,958
Additions to stocks [2]	108,252	(1)	24,581	(1)
Total	928,738	18,062,675	761,498	11,564,162

[1] Data not available.
[2] Calculated to strike a balance.

A survey of the relation of production to total supply for 5-year periods from 1891 to 1943 is given in Minerals Yearbook, 1943 (p. 632). The details, in tonnages, for 1942–46 are shown in the accompanying table.

Total supply, imports for consumption, domestic production, and consumption of chromite, 1942–46, in short tons

	1942	1943	1944	1945	1946
Total supply	1,094,483	1,088,696	894,019	928,738	761,498
Imports for consumption	981,607	928,576	848,390	914,765	757,391
Domestic production	112,876	160,120	45,629	13,973	4,107
Consumption by industry	891,952	964,600	848,449	808,120	734,759

In 1946, the first full postwar year, the decline in domestic production continued for the third successive year. A similar, although quantitatively less abrupt, decrease occurred at the close of World War I. There was nothing in 1946 to indicate an arrest of the downward trend in domestic production, which may be expected to descend to a level below 1,000 tons a year unless technological advances in methods of beneficiation and utilization make the domestic product competitive with imported ores.

The total new supply of all grades of chromite available to industry in 1946 was 18 percent less than in 1945; the supply from domestic mines decreased 71 percent, and imports dropped 17 percent. Exports of chrome ore declined 83 percent.

The accompanying table shows the growth and decline in the production of domestic chromite during the two World War periods.

Chromite shipped from mines in the United States, 1913–21 and 1938–46

Year	Short tons	Year	Short tons
1913	286	1938	999
1914	662	1939	4,048
1915	3,675	1940	2,982
1916	52,680	1941	14,259
1917	48,973	1942	112,876
1918	92,322	1943	160,120
1919	5,688	1944	45,629
1920	2,802	1945	13,973
1921	316	1946	4,107

GOVERNMENT REGULATIONS

Civilian Production Administration and Office of Temporary Controls.—Order M–21 authorizing CPA to exercise controls over alloy steel and ferro-alloying materials (see Minerals Yearbook 1945, p. 608) continued in effect during 1946, but no active controls were instituted.

During 1946, CPA and its successor OTC certified that there was a deficiency of metallurgical chromite for industrial uses and allocated ore from the holdings of the Office of Metals Reserve under the authority of Priorities Regulation 34 and its amendments (of December 17 and 27).

Office of Price Administration.—Amendment 26 to Supplementary Order 129, issued and effective June 12, 1946, suspended price controls under Maximum Price Regulation 258 covering chrome ores, and under MPR 407 governing ferrochrome, chromium metal, and chromium alloys. All materials except sugar and rice were exempted from price control by Supplementary Order 193, issued November 12, 1946, and effective retroactively November 10.

DOMESTIC PRODUCTION

The output of domestic chromite, measured by shipments from mines, in 1946 declined to the lowest point since 1940. Production of chromite in the United States since 1880 has totaled 619,149 tons.

In 1946, as in 1945, only California and Oregon shipped chromite. Two producers mined ore in California, and one in Oregon. The average Cr_2O_3 content of the ore shipped was 44 percent as compared to 46 percent in 1945 and 44 percent in 1944.

Chromite production (shipments) in the United States, 1942–46 by States, in short tons, and number of producers in 1946

State	1942	1943	1944	1945	1946			
					Number of producers	Cr_2O_3, percent		Total
						45 or over	35 to 45	
Alaska		5,569	1,845					
California	44,873	62,495	34,715	9,607	2	[1] 1,335	[1] 2,772	[1] 4,107
Idaho	25							
Montana	65,238	75,691	1,251					
Oregon	2,683	16,363	7,818	4,366	1	(1)	(1)	(1)
Texas		2						
Washington	57							
	112,876	160,120	45,629	13,973	3	1,335	2,772	4,107

[1] California and Oregon production combined. Bureau of Mines not at liberty to publish separate State totals for 1946.

California.—Two counties, Del Norte and San Luis Obispo, furnished all the chromite shipped from California in 1946. Approximately three-fourths of the tonnage came from the French Hill mine in Del Norte County, operated by the Tyson Chrome Mines, Ltd. The San Luis Obispo production was from the Trinidad mine, north of San Luis Obispo, operated by Henry C. Dalessi.

Oregon.—The chromite shipped from Oregon was all from the Oregon Chrome mine, Josephine County, operated by William S. Robertson. Shipments averaged 44½ percent Cr_2O_3 and 11 percent FeO.

EXPLORATION AND DEVELOPMENT

In 1946 the Bureau of Mines published four Reports of Investigations [1]—one on the examination of a chromite deposit, two on the beneficiation of chromite, and one summarizing work on the production of pure chromium metal.

Three articles relating to chrome descriptive of work done during the war years by members of the Geological Survey were published in 1946.[2]

[1] Rutledge, R. A., Exploration of Red Mountain Chromite Deposits, Kenai Peninsula, Alaska: Bureau of Mines Rept. of Investigations 3885, 1946, 26 pp.

Lloyd, R. R., Garst, O. C., Rawles, W. T., Schlocker, J., Dowding, E. P., Mahan, W. M., and Fuchsman, C. H., Beneficiation of Montana Chromite Concentrates by Roasting and Leaching: Bureau of Mines Rept. of Investigations 3834, 1946, 37 pp.

Boericke, F. S., Selective Reduction of Iron in Chromite by Methane-Hydrogen and Similar Gas Mixtures: Bureau of Mines Rept. of Investigations 3847, 1946, 14 pp.

Dean, R. S., The Metallurgical Program of the Bureau of Mines Relating to Iron and Steel: Bureau of Mines Rept. of Investigations 3920, 1946, p. 11.

[2] Guild, Philip L., Chromite in Cuba, 1940–45: The Record, Scientific and Cultural Cooperation, U. S. Department of State, vol. 2, No. 3, March 1946, pp. 12–17.

Thayer, T. P., Preliminary Correlation of Chromite With the Containing Rocks: Econ. Geol., vol. 41, 1946, pp. 202–217.

Dow, D. H., and Thayer, T. P., Chromite Deposits of the Northern Coast Ranges of California: California Division of Mines, Bull. 134, part II, chap. 1.

CONSUMPTION AND USES

In 1946 the total consumption of chromite was 734,759 short tons, a decrease of 73,361 tons (9 percent) from the 1945 figure, and marked the third successive year of decline from the all-time high of 1943. As compared to 1945, the consumption of metallurgical ore dropped 12 percent and that of refractory ore 10 percent, while the use of chemical ore increased 2½ percent. The accompanying table presents the total consumption of chromite and the tenor of ore consumed by primary consumer groups for 1940–46.

Consumption of chromite and tenor of ore used by primary consumer groups in the United States, 1940–46, in short tons

Year	Consumption		Tenor of ore (percent Cr_2O_3)		
	Gross weight (short tons)	Average tenor (percent Cr_2O_3)	Metallurgical	Refractory	Chemical
1940	562,915	45.0	50.5	35.8	47.2
1941	800,290	44.3	50.1	34.8	46.3
1942	891,952	43.2	48.5	34.0	44.8
1943	964,600	43.8	48.5	34.0	44.7
1944	848,449	44.1	49.4	34.2	45.7
1945	808,120	43.8	49.1	34.2	45.0
1946	734,759	43.2	48.3	33.9	44.9

The outstanding feature of the industry in 1946 was the shortage of metallurgical-grade chromite. The relation of consumption of chromite to imports in 1946, by grades, in percent, was as follows:

Grade of ore:	*Consumption percent of imports*
Metallurgical	125
Refractory	76
Chemical	87
Total chromite	97

Inasmuch as domestic production accounted for only 0.5 percent of the new supply in 1946, the importance of imports of chromite ore in meeting demand is evident. The deficiency in imports of metallurgical grade was made up partly by sales of ore by the Office of Metals Reserve (as authorized by CPA and OTC) and partly by the substitution of high-grade chemical ore for metallurgical uses.

The consumption of metallurgical-grade chromite in 1946 declined 12 percent from that in 1945, whereas the production of alloy steel dropped 30 percent. The relatively smaller decrease in the consumption of metallurgical chromite is explained by the fact that the production of stainless steel (the main consumer of ferrochrome) in 1946 virtually equaled that in the previous year.

The metallurgical uses for chromium comprise stainless steels, corrosion- and heat-resisting alloys, high-temperature—high-strength alloys, high-speed steel, tool steels, engineering steels, alloy cast iron, and light-metal alloys. Chromium is added to light-metal alloys to prevent intergranular corrosion; this use is a recent development.

The chemical uses for chromium are given in Minerals Yearbook, 1944 (p. 610).

The use of chrome refractories in lining metallurgical furnaces, particularly the basic open hearth, has long been common practice. A new use for chrome and chrome-magnesite brick in the acid open hearth has been described.[3]

OFFICE OF METALS RESERVE STOCKS

On December 31, 1946, the Office of Metals Reserve had in its possession in the United States, subject to allocation, 635,685 short tons of chromite of all grades, held in central stock piles, at purchase depots, and by agents. The accompanying table shows gross weight and average analyses of the ore by points of origin and by use and grade classification.

Stocks of chromite held by Office of Metals Reserve in the United States in central stock piles, at purchase depots, and in hands of agents, by grades, points of origin, and average analysis, on December 31, 1946

Grade and origin	Gross weight (short tons)	Average analysis		
		Cr_2O_3 (percent)	Fe (percent)	Cr:Fe ratio
Metallurgical ore in stock piles:				
48.00 percent Cr_2O_3 and over:				
Foreign:				
Guatemala	187	50.41	12.74	2.66
New Caledonia	4,174	50.74	10.12	3.44
Rhodesia	2,505	49.89	11.40	2.99
Turkey	33,954	51.17	11.13	3.15
U. S. S. R.	158,118	51.87	10.45	3.40
45.00 to 47.99 percent Cr_2O_3:	198,938	51.70	10.57	3.35
Foreign:				
New Caledonia	5,309	46.22	9.83	3.22
42.00 to 44.99 percent Cr_2O_3:				
Foreign:				
Sierra Leone	21,727	43.01	10.08	2.92
Turkey	2,336	43.60	9.81	3.04
	[1] 24,063	43.25	10.05	2.93
Domestic	22,307	42.34	11.58	2.50
	46,370	42.81	10.78	2.71
35.00 to 41.99 percent Cr_2O_3:				
Foreign:				
Brazil	1,925	39.09	10.21	2.62
Sierra Leone	6,584	39.20	9.31	2.88
	8,509	39.18	9.52	2.82
Domestic	52	40.98	11.28	2.48
	8,561	39.18	9.52	2.82
Total metallurgical ore in stock piles:				
Foreign	236,819	50.27	10.47	3.29
Domestic	22,359	42.33	11.58	2.50
	259,178	49.58	10.56	3.21
Metallurgical ore at purchase depots:				
Domestic:				
48.00 percent Cr_2O_3 and over	2,256	50.10	[1] 12.20	2.81
45.00 to 47.99 percent Cr_2O_3	1,975	46.23	[1] 11.38	2.78
	4,231	48.29	[1] 11.80	2.80
Grand total metallurgical ore	263,409	49.56	[1] 10.60	3.20

[1] Calculated from Cr_2O_3 content and Cr: Fe ratio.

[3] Fayles, R. R., Refractory Applications for Acid Open-Hearth Furnaces: Blast Furnace and Steel Plant, vol. 32, No. 2, February 1947, pp. 217–219.

Stocks of chromite held by Office of Metals Reserve in the United States in central stock piles, at purchase depots, and in hands of agents, by grades, points of origin, and average analysis, on December 31, 1946—Continued

Grade and origin	Gross weight (short tons)	Average analysis		
		Cr_2O_3 (percent)	Fe (percent)	Cr:Fe ratio
Chemical ore in stock piles:				
45.00 to 47.99 percent Cr_2O_3:				
Foreign:				
Transvaal	10,519	45.04	18.96	1.62
42.00 to 44.99 percent Cr_2O_3:				
Foreign:				
Union of South Africa (except Transvaal)	14,204	44.86	18.81	1.63
Transvaal	34,138	43.90	18.79	1.60
	48,342	44.18	18.79	1.61
35.00 to 41.99 percent Cr_2O_3:				
Domestic	42,404	41.39	17.68	1.60
Total chemical ore in stock piles:				
Foreign	58,861	44.33	18.82	1.61
Domestic	42,404	41.39	17.68	1.60
	101,265	43.10	18.34	1.61
Chemical ore at purchase depots:				
Domestic:				
48.00 percent Cr_2O_3 and over	502	48.48	[1] 11.17	2.97
42.00 to 44.99 percent Cr_2O_3	300	42.53	[1] 11.46	2.54
35.00 to 41.99 percent Cr_2O_3	1,600	37.64	[1] 22.20	1.16
	2,402	38.97	[1] 21.00	1.27
Grand total chemical ore	103,667	43.00	[1] 18.39	1.60
Refractory ore in stock piles:				
35.00 to 41.99 percent Cr_2O_3:				
Foreign:				
Cuba (Moa Bay)	101,811	37.03	10.99	2.31
Less than 35 percent Cr_2O_3:				
Foreign:				
Cuba (Camaguey)	136,552	31.03	12.39	1.71
Philippines	13,550	34.19	10.62	2.20
	150,102	31.31	12.23	1.75
Total refractory ore in stock piles:				
Foreign	251,913	33.62	11.73	1.96
Foreign (No analysis)	16,696			
	268,609			
Total OMR chromite stored in United States:				
Foreign	564,289			
Domestic	71,396			
	635,685			

[1] Calculated from Cr_2O_3 content and Cr:Fe ratio.

The over-all decrease in OMR stocks available for allocation in 1946 was 368,984 short tons. Stocks on hand on January 1, 1946 were 1,004,669 tons. Stocks of imported ores dropped 165,929 tons and of domestic ore 203,055 tons. The decreases in the various grades of chromite were as follows; Metallurgical grade, 183,993 tons; chemical grade, 81,191 tons; refractory grade, 43,817 tons; and unclassified domestic ore, 59,983 tons.

Ore is distributed from OMR stocks either through allocations to industry by CPA; or by certification that it is surplus, in which case it is transferred to the national stockpile under the provisions of the Surplus Property Act of 1944 (Public Law 457, approved October 3,

1944) and of the Strategic and Critical Materials Stock Piling Act (Public Law 520, approved July 23, 1946.)

PRICES

OPA price regulations (Minerals Yearbook, 1942, p. 633) governing chromite, chromium alloys, and chromium metal were suspended June 12, and the orders in which they were included were terminated November 10, 1946.

The accompanying table gives the prices quoted during 1946 by the E&MJ Metal and Mineral Markets.

Price quotations for various grades of chromite in 1946, per long ton

[E&MJ Metal and Mineral Markets]

	Cr_2O_3 percent	Cr:Fe ratio	Prices		
			Jan. 1–Oct. 3	Oct. 10–Dec. 10	Dec. 17–Dec. 31
African and Indian	48	2.8:1	$41.00	$38.00 @ $39.00	$36.00 @ $37.00
Do.	48	3:1	43.50	40.00 @ 41.00	38.00 @ 39.00
Do.	48		31.00	29.00 @ 30.00	29.00 @ 30.00
Do.	45			26.00 @ 27.00	27.00 @ 28.00
South African: Transvaal	44		27.40		
Do.	45		28.30		
Do.	48		31.00		
Do.	50		32.80		
Brazilian	44	2½:1	33.65		
Do.	48	3:1	43.50		
Rhodesian	45		28.30		
Do.	48		31.00		
Do.	48	3:1	43.50		
Domestic[1]	48	3:1	43.50	43.50	43.50
Refractory ore			36.50	36.50	36.50

[1] Less $7.00 per ton freight allowance.

Low-carbon ferrochromium was quoted (Metal and Mineral Markets) at 19½ to 54 cents a pound (of Cr contained), dependent on grade and size, during 1946. High-carbon ferrochromium was priced at 13 to 14½ cents from January 1 to June 20, at 14½ to 16½ cents between June 27 and December 12, and at 15.6 to 17.6 cents during the remainder of the year. The price of metallic chromium (generally sold as "chrome metal") was 89 cents a pound for spot transactions and 84 cents on contract.

FOREIGN TRADE[4]

Imports of chromite in 1946 were 757,391 short tons, a decline of 17 percent from 1945. The major countries showing declines were Cuba, New Caledonia, Southern Rhodesia, Turkey, and U. S. S. R. Countries showing substantial increases were India, Philippine Islands, Sierra Leone, and Union of South Africa. Imports of chromium products comprised 1,460 tons of ferrochromium and 1 ton of chromates and dichromates—all from Canada. Exports included 2,510 tons of ferrochrome (valued at $732,221); 2,158 tons of ore ($80,958); and 22 tons of chromium metal, chromium alloys, and chrome-bearing scrap ($31,063).

[4] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Chromite imported for consumption in the United States, 1942–46 by countries

Country	Gross weight (short tons)				1946		
					Short tons		Value
	1942	1943	1944	1945	Gross weight	Cr_2O_3 content	
North America:							
Canada	13,705	17,046	20,296	3,726	8,607	4,090	$269,996
Cuba	137,826	310,729	349,059	297,820	204,268	73,129	2,419,261
Guatemala		2,001	1,016	181			
	151,531	329,776	370,371	301,727	212,875	77,219	2,689,257
South America: Brazil	6,468	9,285	4,278	2,920			
Europe:							
Cyprus		8,400					
U. S. S. R.	30,061	99,922	112,315	166,142	98,952	53,391	4,158,931
	30,061	108,322	112,315	166,142	98,952	53,391	4,158,931
Asia:							
India and Dependencies	21,316	2,800			17,268	8,500	177,964
Philippines, Republic of	30,475				30,465	10,469	242,510
Turkey	119,548	90,778	98,777	70,845	9,015	4,328	233,430
	171,339	93,578	98,777	70,845	56,748	23,297	653,904
Africa: [1]							
Sierra Leone				6,397	32,912	14,164	499,562
Southern Rhodesia	277,272	243,508	187,781	221,855	[2] 99,557	[2] 47,228	[2] 1,285,449
Union of South Africa	262,259	111,602	40,376	110,415	235,340	105,831	1,772,596
	539,531	355,110	228,157	338,667	367,809	167,223	3,557,607
Oceania:							
Australia				73			
New Caledonia [3]	82,677	32,505	34,492	34,391	21,007	11,326	399,422
	82,677	32,505	34,492	34,464	21,007	11,326	399,422
	981,607	928,576	848,390	914,765	757,391	332,456	11,459,121

[1] Sierra Leone listed as British West Africa by the U. S. Department of Commerce.
[2] Southern Rhodesia data for 1946 includes 1,369 tons containing 657 tons chromic oxide valued at $16,375 credited to Mozambique by the U. S. Department of Commerce.
[3] Classified as French Oceania, 1942–44; French Pacific Islands, 1945–46.

WORLD REVIEW

Of the major chromite-producing countries, the accompanying table presents figures from 1939 through 1946 for Cuba, New Caledonia, Southern Rhodesia, Turkey, and Union of South Africa. The record for the Philippines is complete except for 1945 and that of India except for 1946.

Brazil [5]—A new chromite deposit has been found in Piracanjuba, Goias, the tonnage of which has been estimated at 20,000 tons. The Cr_2O_3 content is reported to be 35–42 percent.

Reserves of the Campo Formosa district have been estimated at 4 million tons of 35-percent ore; those of the Santa Luzia district at 100,000 tons of 36–42-percent ore; and those of the Boa Vista district at 20,000 tons of 30- to 35-percent ore.

Japan.[6]—The current productive capacity of Japan, estimated at 52,000 metric tons a year, exceeds any immediately predictable domes-

[5] Bureau of Mines, Mineral Trade Notes: Vol. 23, No. 5, November 1946, pp. 8–9.
Scorza, Evaristo Penna, Chromium in Piracanjuba (Goias, Brazil): Mineraçao Metalurgia, vol. 11, No. 61, 1946, pp. 64–69.
[6] Bardill, John B., The Ferro-Alloy Metallurgy of Japan: Supplement 14 to Bureau of Mines Mineral Trade Notes, May 1947.
Sampson, Edward, Chromite Resources of Japan: General Headquarters, Supreme Commander for the Allied Powers, Natural Resources Section, Rept. 64, Tokyo, 35 pp.

World production of chromite, 1939–46 by countries, in metric tons

[Compiled by B. B. Mitchell]

Country	1939	1940	1941	1942	1943	1944	1945	1946
North America:								
Canada		304	2,152	10,393	26,848	24,543	5,221	2,812
Cuba	59,562	52,347	163,175	286,470	354,152	192,131	172,626	174,170
Guatemala	564	136	697	529	374	97	442	600
Mexico	(1)	(1)	12	17				(2)
United States	3,672	2,705	12,935	102,400	145,259	41,394	12,676	3,726
South America:								
Argentina			60	210	250	181	(1)	(1)
Brazil (exports)	3,554	4,572	5,944	5,776	7,813	4,721	1,490	
Europe:								
Albania	3,070	[3] 14,000	[4] 20,000	[3] 5,000	(1)	(1)	(1)	(1)
Bulgaria	4,251	6,000	(1)	[3] 6,500	[3] 7,000	(1)	(1)	(1)
Greece	57,091	29,721	16,240	24,300	15,500	18,295	2,413	8,500
Norway	371						(1)	(1)
Portugal					1,267	1,500	1,669	(1)
Sweden				80	224	127		(1)
United Kingdom (shipments)	(1)	[3] 1,200	(1)	[3] 500	[3] 500	(1)	(1)	(1)
Yugoslavia	59,527	71,019	(1)	[3] 100,000	[3] 65,000	(1)	(1)	(1)
Asia:								
Cyprus (exports)	1,118	2,540	4,816	2,936	7,986	469	1,070	1,158
India	49,925	56,402	50,940	50,380	33,789	40,190	31,105	(1)
Indochina				3,570	6,510	2,300		(1)
Iran					[5] 435	[5] 1,267	(1)	(1)
Japan [6]	57,394	56,703	54,510	67,540	58,520	71,135	28,539	7,079
Philippines, Republic of	135,573	200,889	[3] 300,000	[3] 50,000	[3] 60,000	[3] 70,000	(1)	58,000
Turkey	191,644	169,823	150,303	144,704	196,836	184,573	146,997	109,302
U. S. S. R.	(1)	(1)	(1)	[7] 400,000	[3] 325,000	(1)	(1)	(1)
Africa:								
Egypt				312	910	150	150	
Sierra Leone	10,755	17,777	[5] 15,131	[3] 15,000	16,305	9,835	578	(1)
Southern Rhodesia	139,083	247,724	323,935	348,314	287,453	277,051	186,318	151,433
Union of South Africa	160,014	163,646	141,884	337,620	163,232	88,909	99,090	188,928
Oceania:								
Australia:								
Queensland						1,125	(1)	(1)
New South Wales	118	279	356	365	412	246	287	(1)
New Caledonia	57,290	55,790	64,509	67,610	46,952	55,229	40,826	24,946
Total world production [8]	1,163,000	1,458,000	1,835,000	2,030,000	1,828,000	1,450,000	1,100,000	1,100,000

[1] Data not available; estimates by the author included in the total.
[2] Less than one ton.
[3] Estimate.
[4] Estimate may include some production in Yugoslavia.
[5] Fiscal year ended March 20 of year stated.
[6] Preliminary.
[7] Planned production.
[8] Exports.

tic demand. With an assumed steel production of 3 million tons a year, requirements for chromite for all uses are estimated at 40,000 metric tons. In 1944, the year of peak production, the output of chromite in Japan was 71,000 tons. Reserves are estimated to be 452,000 tons of "proved, probable, and possible" ore and 275,000 tons of "speculative" ore. Production has been from four groups of mines—the Tottori-Okayama area, Honshu; the Hidaka-Iburi area, Southern Hokkaido; the placer deposits in Northern Hokkaido; and scattered small deposits. Imports were from New Caledonia (1933–40) and the Philippine Islands (1935–45).

Japanese production of ferrochrome 1925–45 totaled 167,570 metric tons. The peak production was in 1943, when the output was 31,932 tons. High-carbon ferrochrome was produced in the electric furnace, using limestone as a flux and coke as a reducing agent. The low-carbon alloy was made in three steps—the production of high-carbon ferrochrome; the conversion of the high-carbon alloy into a high silicon ferrochrome by smelting in a second furnace with silica and coke; and

finally the production of the low-carbon alloy by smelting the high-silicon alloy with ore in a third electric furnace, which is chromite-lined and has low-carbon ferro-chrome electrodes.

Southern Rhodesia.[7]—The total exports of chromite from Southern Rhodesia and exports of Rhodesian chromite to the United States 1939–46 have been:

Year	Total exports from Southern Rhodesia (metric tons)	Rhodesian exports of chromite to the United States (metric tons)	Percent exports to United States
1939	107,707	52,848	49
1940	279,818	212,247	76
1941	313,308	218,667	70
1942	348,051	310,302	89
1943	266,273	195,388	73
1944	271,624	173,009	64
1945	207,722	137,952	66
1946	151,956	86,694	57
Total	1,946,459	1,387,107	71

Imports of Rhodesian chromite into the United States for the same period (1,389,519 metric tons) agree with the reported Rhodesian export figure to 0.8 percent.

The current output from Southern Rhodesia originated as follows: 58 percent from the Gwelo district, 33 percent from the Salisbury district, and 9 percent from the Victoria district. In the last two areas the chromite is found along the Great Dyke of norite. In the summer of 1946 stocks of ore at the mines totaled over 320,000 tons. The unsatisfactory condition of the railroad from the mines to the port of Beira, described in previous chapters of this series, showed no improvement in 1946.

Diamond drilling of a new deposit at Selukwe Peak has revealed an ore body estimated to contain 700,000 tons of metallurgical-grade ore. Preparations are being made to begin mining operations at this deposit.

Sweden.[8]—Mining of chromite was resumed in Sweden in 1942, when 80 tons were produced. The output in 1943 was 224 tons, and in 1944 it declined to 127 tons. A previous production of 31 tons in 1910 is reported in Mineral Resources of the United States, 1913, part 1, p. 30.

United Kingdom.[9]—British imports of chromite and ferrochromium 1945–46 (in tons) were:

	1945	*1946*
Chrome ore:		
Union of South Africa	8,537	5,325
Southern Rhodesia	37,584	51,408
India	4,161	758
Other	105	9,443
	50,387	66,934
Ferrochrome	3,199	3,809

[7] Bureau of Mines, Mineral Trade Notes: Vol. 22, No. 6, June, 1946, p. 11.
Bureau of Mines, Mineral Trade Notes: Vol. 23, No. 3, Sept. 1946, pp. 9–10.
[8] Bureau of Mines, Mineral Trade Notes: Vol. 23, No. 1, July 1946, p. 4.
[9] Metal Bulletin (London), British Imports: No. 3165, Jan. 28, 1947, p. 3.

Clays

By G. W. JOSEPHSON AND A. LINN[1]

GENERAL SUMMARY

THE FULL effect of postwar demand was apparent in the clay industry in 1946. Output in all classes was greater than in 1945, and several new records were established. Over all, 62 percent more clay was produced in 1946 than in 1945.

Stimulated by a demand that was backed by both legislative encouragement and large private funds, building construction reached boom proportions. Consequently, the production of common clays for use in heavy-clay products and cement—two of the largest clay-consuming industries—nearly doubled.

High activity in the ceramic, paper, and rubber industries enabled new records to be set for the output of kaolin and of ball clay.

As usual, a new record was also established for bentonite, principally owing to increased sales to oil-well drillers.

The production of refractories and heavy-clay products required more fire clay in 1946 than in 1945. Refractories output was at a very high level, although not as high as the wartime record.

Fuller's earth registered a small increase, owing to a gain in sales for oil filtering and decolorizing, which offset a loss in absorbent uses.

Salient statistics of the clay industry in the United States, 1945–46

	1945		1946	
	Short tons	Value	Short tons	Value
Domestic clay sold or used by producers:				
Kaolin or china clay	939,988	$9,072,927	1,322,303	$13,553,767
Ball clay	174,524	1,589,875	243,145	2,395,902
Fire clay, including stoneware clay	6,090,411	15,587,034	7,907,974	20,827,220
Bentonite	573,998	3,770,625	601,428	4,361,414
Fuller's earth	296,368	3,463,913	298,752	3,702,993
Miscellaneous clays	10,848,686	9,774,854	20,190,344	16,022,012
	18,923,975	43,259,228	30,563,946	60,863,308
Imports:				
Kaolin or china clay	57,497	871,541	89,233	1,440,746
Common blue and Gross-Almerode	17,852	184,554	22,683	270,472
Fuller's earth	336	4,647	194	3,639
Other clay	1,636	9,078	4,249	21,532
	77,321	1,069,820	116,359	1,736,389
Exports:				
Kaolin or china clay	12,402	130,977	15,878	198,679
Fire clay	94,602	630,751	97,941	657,905
Other clay (including fuller's earth)	77,436	1,494,479	100,598	2,283,326
	184,440	2,256,207	214,417	3,139,910

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

In harmony with most other commodities, the prices of clay and clay products trended upward during 1946.

Foreign trade in clay increased considerably in 1946, but the tonnage was relatively modest when compared with movements recorded in prewar years. A measure of the decline in the dependence of the United States on high-grade foreign clays is seen in the following total import figures: 1925–29 average—420,310 tons; 1930–34 average—181,615 tons; 1935–39 average—168,518 tons; 1946—116,359 tons. On the other hand, our exports have developed as follows: 1925–29 average—109,344 tons; 1930–34 average—108,687 tons; 1935–39 average—149,071 tons; 1946—214,417 tons.

CONSUMPTION AND USES

The clay-consumption statistics in the accompanying table were compiled from producers' reports. These figures are comparable with similar statistics published in Minerals Yearbooks covering 1945 and 1944, and those of kaolin, ball clay, bentonite, and fuller's earth are comparable for previous years as well. Some of the fire-clay and miscellaneous clay figures are not comparable with those published prior to 1944, owing to exclusion of captive tonnage in the earlier years. The relationship is outlined in greater detail in the Clays chapter of Minerals Yearbook, 1944.

The principal consuming industries in 1946 were as follows: Heavy-clay products (57 percent of the total), refractories (17 percent), cement (16), paper (2), rotary drilling mud (1), pottery (1), and filtering and decolorizing (1).

Clay sold or used by producers in the United States in 1946, by kinds and uses, in short tons

Use	Kaolin	Ball clay	Fire clay and stoneware clay	Bentonite	Fuller's earth	Miscellaneous clay including slip clay	Total
Pottery and stoneware:							
Whiteware, etc.	107,295	205,015	5,371				317,681
Stoneware, including chemical stoneware			36,256				36,256
Art pottery and flower pots	4,242	10,631	19,197			32,739	66,809
Slip for glazing						3,083	3,083
Total	111,537	215,646	60,824			35,822	423,829
Tile, high-grade	14,321	17,104	114,975			11,879	158,279
Kiln furniture:							
Saggers, pins, stilts	10,039	2,000	30,484				42,523
Wads			3,198				3,198
Total	10,039	2,000	33,682				45,721
Architectural terra cotta		1,729	3,232				4,961
Paper:							
Filler	448,756						448,756
Coating	248,527						248,527
Total	697,283						697,283
Rubber	162,393		11,006			1,945	175,344
Linoleum and oilcloth	13,323	258	4,463				18,044
Paints:							
Filler or extender	21,835		532			283	22,650
Calcimine	393						393
Total	22,228		532			283	23,043
Cement manufacture	47,559	328	22,218	25		4,772,910	4,843,040

Clay sold or used by producers in the United States in 1946, by kinds and uses, in short tons—Continued

Use	Kaolin	Ball clay	Fire clay and stoneware clay	Bentonite	Fuller's earth	Miscellaneous clay including slip clay	Total
Refractories:							
Fire brick and block	123,300		3,351,790				3,475,090
Bauxite, high alumina brick			89,774				89,774
Fire-clay mortar, including clay processed for laying fire brick	1,912		222,391				224,303
Clay crucibles	4,379	120	1,238				5,737
Glass refractories	293	515	18,519				19,327
Zinc retorts and condensers			56,648			250	56,898
Foundries and steelworks	2,373		678,161	165,044		22,052	867,630
Other refractories	451		528,323				528,774
Total	132,708	635	4,946,844	165,044		22,302	5,267,533
Heavy-clay products: Common brick, face brick, paving brick, drain tile, sewer pipe, and kindred products	10,481		2,597,819			14,790,298	17,398,598
Miscellaneous:							
Rotary drilling mud			467	231,252	9,776	196,662	438,157
Filtering and decolorizing oils (raw and activated earths)				144,221	[1]227,088		371,309
Other filtering and clarifying				5,968	2,992		8,960
Artificial abrasives	10,213	648	411			206	11,478
Absorbent uses (oily floors, etc.)	167				49,036		49,203
Asbestos products	2,582						2,582
Chemicals	20,996		71,252	600			92,848
Enameling	10	258	100				368
Filler (other than paper or paint)	31,337			3,522	117		34,976
Insecticides	19,305			5,279	5,558	919	31,061
Plaster and plaster products	8,148		1,336				9,484
Concrete admixture, sealing dams, etc				1,227			1,227
Other uses	7,673	4,539	38,813	44,290	4,185	357,118	456,618
Total	100,431	5,445	112,379	436,359	298,752	554,905	1,508,271
Grand total:							
1946	1,322,303	243,145	7,907,974	601,428	298,752	20,190,344	30,563,946
1945	939,988	174,524	6,090,411	573,998	296,368	10,848,686	18,923,975

[1] Comprises following: Mineral oils, 202,722 tons; vegetable oils, 24,366 tons.

CHINA CLAY OR KAOLIN

In 1946, output of kaolin attained a new record—22 percent above the previous high established in 1941. As is shown on the accompanying chart, kaolin production was well-maintained during the war, and the high level of postwar industrial activity has increased demand to a record level.

Kaolin has a substantial market in the pottery industry, but even greater tonnages are consumed in the paper, rubber, and refractories industries. In 1946, 53 percent of the total was used as paper filler and coating, 12 percent in rubber, 10 percent in refractories, and 8 percent in pottery.

The postwar demand for high-quality paper has been extremely great; consequently, paper kaolin sales increased 27 percent over the tonnage sold in 1945.

During the war, the use of kaolin in rubber declined because synthetic rubber compounding requires less kaolin than does natural and production of mechanical goods was restricted. When the war was

over, the demand for rubber clay boomed as output of mechanical goods increased, more natural rubber became available, and greater emphasis was placed on color and sales appeal of rubber products. Consequently, sales of rubber clay in 1946 were 48 percent greater than in 1945.

The tonnage of kaolin reported as used in the production of refractories increased to 132,708 tons in 1946 but was below the record of 159,886 tons set in 1942.

Consumption of kaolin in the pottery industry was 51 percent greater than in 1945.

Kaolin prices were increased somewhat during the year. Trade-journal prices ranged from as low as $2.50 per ton for sagger clay, through $6–$30 for most processed types. A few specialties sell as high as $40. The national average value, as reported by producers to the Bureau of Mines, increased from $9.65 in 1945 to $10.25 in 1946. At the end of the year the ex dock price of imported china clay was $20–$22 lump bulk, carload; and $45 for powdered, casks, l. c. l., ex warehouse.

Imports of kaolin increased from 57,497 tons in 1945 to 89,233 tons in 1946 but were still considerably below the prewar average. A total of about 31 tons came from Canada, Brazil, Argentina, and Czechoslovakia and 89,202 tons from England. Continuation of the fuel and labor shortage in Great Britain has handicapped the efforts of producers in England to recapture their prewar markets in the United States. English china clay still is in demand in the United States, but the beneficiation of American kaolin has progressed so far that foreign clays find it difficult to compete in many uses. China clay is produced in England with relatively simple equipment and methods that have been in use for a long time. During the past year a committee from England studied American practice to determine the feasibility of improving their production methods.

Kaolin sold or used by producers in the United States, 1945–46, by States

State	Sold by producer		Used by producer		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1945						
California	6,385	$72,418	1,901	$8,182	8,286	$80,600
Georgia	629,531	6,278,411	72,857	406,116	702,388	6,684,527
Pennsylvania	13,965	50,589			13,965	50,589
South Carolina	159,550	1,467,328			159,550	1,467,328
Undistributed [1]	55,799	789,883			55,799	789,883
	865,230	8,658,629	74,758	414,298	939,988	9,072,927
1946						
California	(2)	(2)	(2)	(2)	18,254	152,898
Georgia	815,367	9,106,878	102,385	564,171	917,752	9,671,049
Pennsylvania	(2)	(2)	(2)	(2)	42,186	147,262
South Carolina	(2)	(2)	(2)	(2)	270,016	2,493,031
Undistributed [3]	376,124	3,805,989	28,427	76,729	74,095	1,089,527
	1,191,491	12,912,867	130,812	640,900	1,322,303	13,553,767

[1] Includes Alabama, Florida, Illinois, North Carolina, Utah, and Virginia.
[2] Included with "Undistributed."
[3] Includes Alabama, Florida, Illinois, Maryland, North Carolina, Utah, Virginia, and figures indicated by footnote 2.

Exports of kaolin are reported by the United States Department of Commerce to have totaled 15,878 short tons valued at $198,679 in 1946, a slight increase over the 12,402 tons valued at $130,977 reported for 1945.

Georgia kaolin sold or used by producers, 1942–46, by uses

Year	China clay, paper clay, etc.			Refractory uses			Total kaolin		
	Short tons	Value		Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton		Total	Average per ton
1942	594,780	$5,645,760	$9.49	149,628	$490,471	$3.28	744,408	$6,136,231	$8.24
1943	596,075	5,810,922	9.75	136,515	421,650	3.09	732,590	6,232,572	8.51
1944	579,922	5,545,045	9.56	94,478	278,379	2.95	674,400	5,823,424	8.63
1945	616,736	6,305,132	10.22	85,652	379,395	4.43	702,388	6,684,527	9.52
1946	798,739	9,075,123	11.36	119,013	595,926	5.01	917,752	9,671,049	10.54

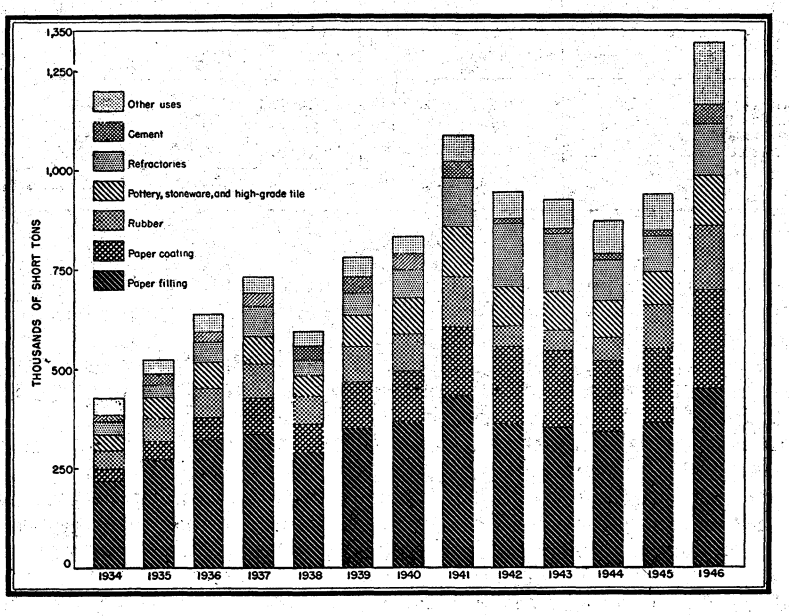

FIGURE 1.—Kaolin sold or used by domestic producers for specified uses, 1934–46.

BALL CLAY

Reflecting increased activity in the American pottery industry, the record output of ball clay established in 1941 was exceeded by 23 percent in 1946.

As in former years, most of the output in 1946 came from the Tennessee-Kentucky area. These two States furnished 95 percent of the total tonnage. Tennessee contributed 54 percent of the total, Kentucky 41, and Maryland and New Jersey together the remaining 5 percent.

Prices of domestic ball clay quoted in trade journals ranged from $3 to over $18 per ton according to grade. The average value reported by producers to the Bureau of Mines increased from $9.11 per ton in 1945 to $9.85 in 1946.

As shown in the use table, small quantities of ball clay are consumed in such products as refractories, cement, enamelware, linoleum, terra cotta, and tile, but the bulk (89 percent of the total in 1946) is used in pottery and stoneware.

Imports of "common blue and ball clay" increased to 22,683 short tons valued at $270,472 in 1946. All except 231 tons, which entered from Canada, came from the United Kingdom. The imported clay had a foreign market value, exclusive of freight and other charges, of almost $12 per ton in 1946, whereas in 1941 the value was approximately $9 per ton. Imports now provide only about 9 percent of the ball clay consumed in the United States.

Ball clay sold by producers in the United States, 1944–46, by States

State	1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value
Kentucky	72,729	$669,419	80,077	$744,599	98,918	$990,301
Maryland, New Jersey	9,599	82,380	11,612	92,987	12,538	106,208
Tennessee	73,339	624,297	82,835	752,289	131,689	1,299,393
	155,667	1,376,096	174,524	1,589,875	243,145	2,395,902

FIRE CLAY

Owing to the high demand for refractories and building materials, output of fire clay in 1946 was 30 percent greater than in 1945 and was close to the record set in 1942.

As there is a large tonnage of low-grade fire clay that is used mainly in Ohio in the manufacture of heavy-clay products, the building boom accounts for much of the rise in fire-clay output in 1946. Consumption in this use almost doubled. There was also a noteworthy increase of 11 percent (almost 500,000 tons) in consumption in refractory uses. As shown in the table in the Consumption and Uses section of this chapter, 63 percent of the total tonnage was consumed in refractories, 33 percent in heavy-clay products, and the remainder in a variety of other uses.

Fire clay is widely distributed, but, as quality varies greatly and the large markets are in the Midwest and East, much of the output comes from a few States. In 1946, Ohio supplied 30 percent of the total, Pennsylvania 19, and Missouri 15. Other producing States are shown in the accompanying table.

The average value of fire clay sold on the open market in 1946 was $2.64 a short ton as compared with $2.52 in 1945. The average value of all fire clay, including both captive and open market output, was $2.63, somewhat higher than the $2.56 reported in 1945.

Exports of fire clay totaled 97,941 short tons, only slightly higher than in 1945. Of this, 75 percent was shipped to Canada, 9 percent to Mexico, and the remainder in comparatively small lots to 47 other countries. No imports of fire clay were reported in 1946.

Fire clay, including stoneware clay [1] sold or used by producers in the United States, 1945–46, by States

State	Sold by producer		Used by producer		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1945						
Alabama	78,805	$145,654	10,798	$40,883	89,603	$186,537
Arkansas	(2)	(2)	(2)	(2)	87,570	273,117
California	187,534	508,169	83,668	148,827	271,202	656,996
Colorado	44,338	80,555	38,122	67,942	82,460	148,497
Illinois	157,617	426,212	84,383	144,364	242,000	570,576
Indiana	86,078	111,305	51,118	84,036	137,196	195,341
Kentucky	49,890	230,309	286,712	798,890	336,602	1,029,199
Maryland	12,680	83,834	35,853	103,560	48,533	187,394
Missouri [3]	241,406	480,251	848,678	1,656,604	1,090,084	2,136,855
New Jersey	83,239	510,572	50,957	121,430	134,196	632,002
Ohio	563,032	1,091,576	1,050,038	2,336,588	1,613,070	3,428,164
Pennsylvania	285,962	792,067	1,072,867	3,640,900	1,358,829	4,432,967
Tennessee	(2)	(2)	(2)	(2)	21,474	109,266
Texas	(2)	(2)	(2)	(2)	107,166	360,054
Utah	(2)	(2)	(2)	(2)	8,762	21,432
Washington	(2)	(2)	(2)	(2)	63,812	113,466
West Virginia	53,933	115,342	214,087	823,243	268,020	938,585
Other States [4]	30,803	153,350	387,813	890,571	129,832	166,586
	1,875,317	4,729,196	4,215,094	10,857,838	6,090,411	15,587,034
1946						
Alabama	92,098	168,496	37,649	125,029	129,747	293,525
Arkansas	(2)	(2)	(2)	(2)	178,246	547,509
California	220,753	438,710	100,180	205,714	320,933	644,424
Colorado	60,083	107,406	46,750	97,853	106,833	205,259
Illinois	166,437	511,896	122,328	254,736	288,765	766,632
Indiana	186,918	237,216	121,685	249,292	308,603	486,508
Kentucky	58,033	301,154	367,859	1,295,708	425,892	1,596,862
Maryland	15,243	89,877	71,591	168,204	86,834	258,081
Missouri [3]	267,893	674,777	905,439	2,248,428	1,173,332	2,923,205
New Jersey	88,969	603,297	159,010	382,469	247,979	985,766
Ohio	678,728	1,442,813	1,660,987	3,326,360	2,339,715	4,769,173
Pennsylvania	280,336	905,145	1,257,262	4,502,231	1,537,598	5,407,376
Tennessee	(2)	(2)	(2)	(2)	26,254	101,265
Texas	(2)	(2)	(2)	(2)	200,959	484,649
Utah	(2)	(2)	(2)	(2)	18,932	51,936
Washington	14,989	20,023	56,227	94,112	71,216	114,135
West Virginia	(2)	(2)	(2)	(2)	227,913	838,824
Other States [5]	83,141	333,969	787,386	2,042,305	218,223	352,091
	2,213,621	5,834,779	5,694,353	14,992,441	7,907,974	20,827,220

[1] Includes stoneware clay as follows: 1945—98,309 tons, $186,589; 1946—146,254 tons, $280,116.
[2] Included with "Other States."
[3] Includes diaspore and burley clay as follows: 1945—diaspore, 20,635 tons, $166,501; burley, 37,472 tons, $86,913. 1946—diaspore, 44,434 tons, $338,935; burley, 35,468 tons, $134,693.
[4] Includes Delaware, Idaho, Massachusetts, Michigan, Minnesota, Mississippi, Nebraska, New Mexico, North Carolina, North Dakota, Oregon, South Carolina, and States indicated by footnote 2.
[5] Includes Delaware, Idaho, Iowa, Massachusetts, Michigan, Minnesota, Mississippi, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oregon, South Carolina, Virginia, and States indicated by footnote 2.

BENTONITE

In 1946, for the eighth consecutive year, a new bentonite-production record was set. Output exceeded the 1945 total by 5 percent. The principal uses of bentonite are as a bond for foundry sand (27 percent of the total in 1946), for filtering and decolorizing oils (24 percent), and in rotary-drilling mud for suspension of drill cuttings and control of gas pressure (38 percent). The remainder went into a wide variety of applications as indicated in the use table. In 1946 the quantity of bentonite used in foundries and in filtering and decolorizing was within a few thousand of the 1945 tonnage. On the other hand, sales for drilling mud increased by 68,834 tons (42 percent).

As in 1945, the Wyoming-South Dakota area furnished 66 percent of the total; 35 percent was produced in Wyoming, 31 percent in South Dakota. Texas furnished 4 percent. The bulk of the remainder came from Mississippi and Arizona and minor tonnages from Montana, California, Utah, Colorado, Nevada, and Oklahoma.

Bentonite sold or used by producers in the United States, 1944–46, by States

State	1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value
California	6,649	$60,404	16,187	$145,424	(1)	(1)
South Dakota	169,893	1,104,919	178,374	1,202,555	186,707	$1,394,378
Texas	24,081	216,861	24,503	247,940	21,576	192,891
Wyoming	196,138	1,711,193	199,293	1,686,912	212,530	1,988,918
Undistributed [2]	150,007	512,611	155,641	487,794	180,615	785,227
	546,768	3,605,988	573,998	3,770,625	601,428	4,361,414

[1] Included with "Undistributed."
[2] Includes Arizona, Mississippi, and Utah; in addition, Colorado and Montana in 1945–46 and California, Nevada, and Oklahoma in 1946.

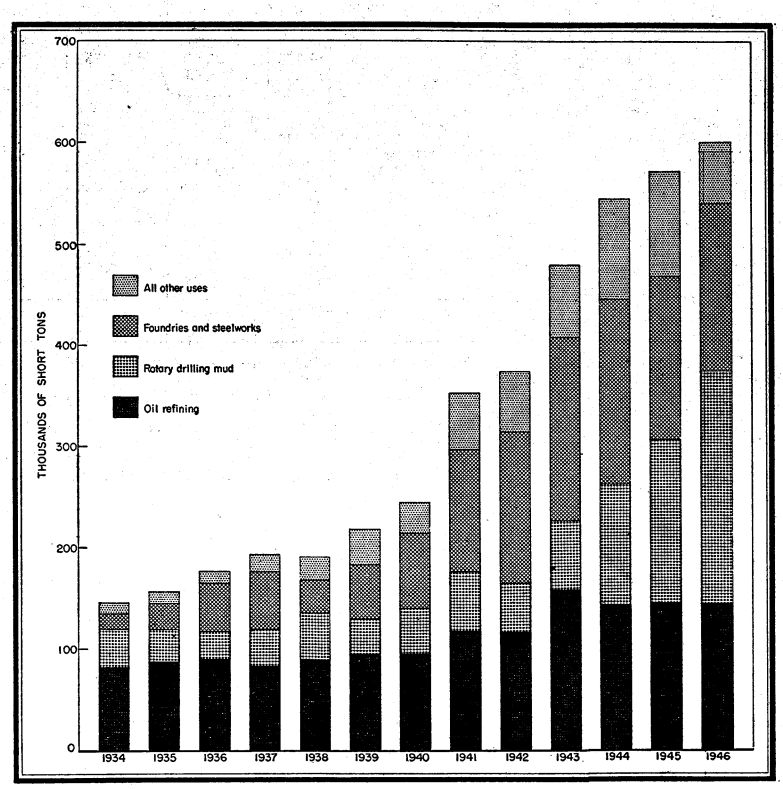

FIGURE 2.—Bentonite sold or used by domestic producers for specified uses, 1934–46.

Bentonite prices quoted in trade journals in 1946, as in the previous year, were: Dried and crushed, in bulk, $7.50; pulverized, 200-mesh, bagged, $9.50 to $11; pulverized, 325-mesh, bagged, $16. However, prices probably advanced somewhat, as the average value reported by producers to the Bureau of Mines increased from $6.57 per ton in 1945 to $7.25 in 1946.

No imports of bentonite were reported by the United States Department of Commerce in 1946. Exports of bentonite are not recorded separately; but producers reported to the Bureau of Mines that they exported about 25,000 tons, most of which went to Europe and countries in the Western Hemisphere. This figure does not include dealer exports or acid-treated bentonite shipped to foreign oil refineries.

FULLER'S EARTH

As shown in the accompanying chart, the output of fuller's earth has increased substantially in recent years. Since reaching a low in 1940, gains have been registered nearly every year, although the rate of increase has been very small during the past 2 years. As in 1945, output rose 1 percent in 1946.

The principal market for fuller's earth is in the oil industries. Producers reported sales of 202,722 tons (68 percent of the total) for filtering and decolorizing mineral oils and 24,366 tons (8 percent) for vegetable and animal oils. Consumption in the oil industry declined greatly during the nineteen thirties under the pressure of competition from acid-treated bentonite and other processed bleaching materials; but after 1940 demand increased, and during the past few years sales have been relatively stable at somewhat over half the tonnage shipped in 1930.

During the war, the outstanding market development in the industry was the successful application of fuller's earth as an absorbent on oily floors. The product was welcomed in machine shops and other industrial plants and sales increased rapidly to 57,700 tons in 1945. Producers reported that the market declined to about 49,000 tons in 1946.

In 1946 the Georgia-Florida district furnished 48 percent of the total tonnage and 57 percent of the value. Texas, with 37 percent of the total, reported more output than any other State.

The value of fuller's earth varies widely according to quality and preparation. In 1946, the average value reported by producers was $10.46 a short ton for Texas and $14.57 for Georgia-Florida. These compare with $9.04 and $14.43, respectively, in 1945. Prices quoted in trade journals during 1946 were as follows: Georgia and Florida, 30- to 60-mesh, $14.50 per short ton; 15- to 30-mesh, $14; 200-mesh up, $10; and 100-mesh up, $7.

Imports of fuller's earth are very small. In 1946, 194 short tons valued at $3,639 were imported into the United States. Exports of fuller's earth are not classified separately, but producers reported to the Bureau of Mines that they shipped 17,748 short tons valued at $223,185 to Western Hemisphere and European countries.

Fuller's earth sold or used by producers in the United States, 1944–46, by States

State	1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value
Florida and Georgia	128,654	$1,833,682	134,401	$1,939,035	144,214	$2,100,652
Illinois	42,277	390,346	43,664	403,084	33,134	296,637
Texas	111,212	916,159	103,076	931,878	110,693	1,157,892
Other States [1]	12,594	156,877	15,227	189,916	10,711	147,812
	294,737	3,297,064	296,368	3,463,913	298,752	3,702,993

[1] Includes California, Nevada, Tennessee, and Utah.

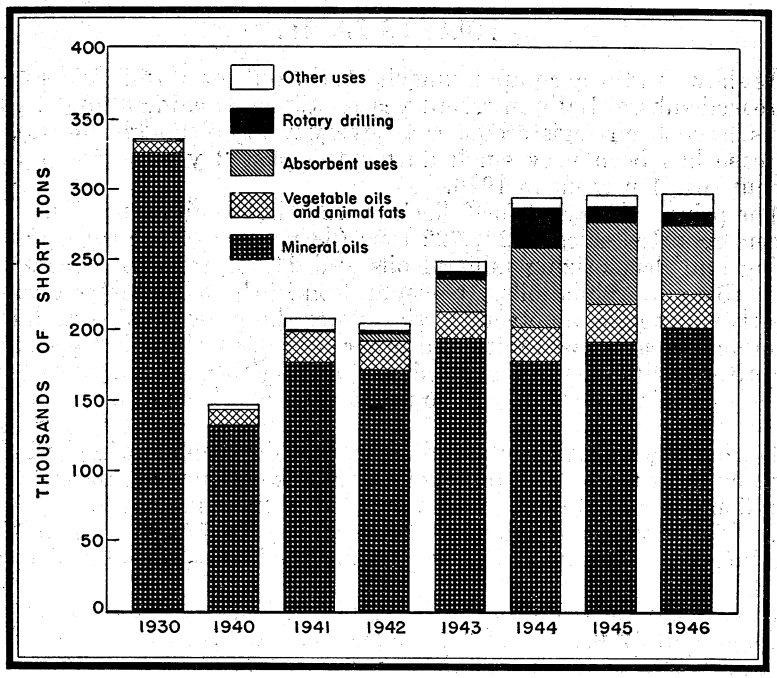

FIGURE 3.—Fuller's earth sold or used by producers for specified uses, 1930 and 1940–46.

MISCELLANEOUS CLAYS

The various types of clay in the foregoing sections of this chapter are classified according to a practical pattern of composition and use that has grown up over a period of years. There remains a very large tonnage of clay and shale of uncertain or divergent specifications that is used in making heavy-clay products and portland cement. With these are grouped, in this "Miscellaneous" section, relatively minor quantities of slip clay, oil-well drilling mud, pottery clay, and small tonnages that find other special uses.

As a result of the boom in construction, the output of miscellaneous clays in 1946 nearly doubled the 1945 tonnage. Approximately 73 percent of the total was used in the manufacture of heavy-clay products and 24 percent in cement production.

Most of this material was captive tonnage mined by the companies near the processing plants and first entered the market as brick, cement, tile, etc. That portion of the miscellaneous clay sold as raw clay by the producer had an average value of $1.79 per ton in 1946 (some of the specialties sold for over $10). The value of the captive clay, most of which is produced in relatively well mechanized mines, is compiled from individual estimates that generally are $1 or less per ton.

As shown in the accompanying table, production of miscellaneous clays was reported from nearly every State. California, Illinois, Michigan, New York, Ohio, Pennsylvania, and Texas were the leading States, each producing more than a million tons in 1946.

Miscellaneous clays, including slip clay and shale, sold or used by producers in the United States, 1945–46, by States

State	Sold by producer [1]		Used by producer [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1945						
Alabama	(3)	(3)	(3)	(3)	639,668	$469,547
Arizona			59,715	$44,786	59,715	44,786
Arkansas			191,827	153,921	191,827	153,921
California	220,059	$779,582	696,638	449,316	916,697	1,228,898
Colorado	(3)	(3)	(3)	(3)	78,650	67,302
Connecticut			63,825	47,597	63,825	47,597
Georgia			554,276	423,794	554,276	423,794
Illinois	(3)	(3)	(3)	(3)	1,124,635	957,728
Indiana	36,691	27,598	260,643	206,929	297,334	234,527
Iowa	3,659	37,960	451,527	363,910	455,186	401,870
Kansas			254,764	196,950	254,764	196,950
Kentucky	(3)	(3)	(3)	(3)	68,815	70,189
Louisiana	(3)	(3)	(3)	(3)	66,891	69,357
Maryland	(3)	(3)	(3)	(3)	154,801	132,382
Massachusetts	(3)	(3)	(3)	(3)	48,409	37,104
Michigan	(3)	(3)	(3)	(3)	585,778	450,417
Mississippi	(3)	(3)	(3)	(3)	55,837	59,578
Missouri	(3)	(3)	(3)	(3)	265,265	174,805
Montana			23,778	23,778	23,778	23,778
Nebraska	(3)	(3)	(3)	(3)	35,515	33,857
New Jersey	(3)	(3)	(3)	(3)	111,751	109,980
New Mexico	(3)	(3)	(3)	(3)	18,438	19,048
New York	(3)	(3)	(3)	(3)	320,683	272,302
North Carolina			503,279	472,147	503,279	472,147
Ohio	(3)	(3)	(3)	(3)	772,694	620,151
Oklahoma			243,358	178,658	243,358	178,658
Oregon	(3)	(3)	(3)	(3)	125,462	87,571
Pennsylvania	40,807	35,186	777,935	829,209	818,742	864,395
South Carolina			220,734	184,920	220,734	184,920
Tennessee	(3)	(3)	(3)	(3)	377,798	334,943
Texas	90,511	337,207	623,820	498,503	714,331	835,710
Utah			44,868	55,924	44,868	55,924
Virginia			193,783	137,297	193,783	137,297
Washington	(3)	(3)	(3)	(3)	119,197	91,371
West Virginia	(3)	(3)	(3)	(3)	80,060	65,283
Wisconsin	(3)	(3)	(3)	(3)	61,071	46,734
Undistributed [4]	305,146	389,436	4,987,043	3,900,246	180,771	120,033
	696,873	1,606,969	10,151,813	8,167,885	10,848,686	9,774,854

See footnotes at end of table.

Miscellaneous clays, including slip clay and shale, sold or used by producers in the United States, 1945–46, by States—Continued

State	Sold by producer [1]		Used by producer [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1946						
Alabama	(3)	(3)	(3)	(3)	924,215	$679,527
Arizona			104,825	$65,694	104,825	65,694
Arkansas			210,360	165,397	210,360	165,397
California	237,172	$631,785	1,087,279	745,696	1,324,451	1,377,481
Colorado	27,593	42,941	166,526	119,020	194,119	161,961
Connecticut			199,238	148,053	199,238	148,053
Florida			54,200	31,900	54,200	31,900
Georgia	(3)	(3)	(3)	(3)	723,908	551,116
Idaho	(3)	(3)	(3)	(3)	11,963	8,033
Illinois	33,771	29,759	2,001,386	1,439,948	2,035,157	1,469,707
Indiana	71,688	53,330	603,378	465,039	675,066	518,369
Iowa	5,556	67,578	691,138	553,192	696,694	620,770
Kansas			464,033	283,350	464,033	283,350
Kentucky			210,535	159,743	210,535	159,743
Louisiana	(3)	(3)	(3)	(3)	178,331	141,526
Maine			19,128	13,377	19,128	13,377
Maryland			306,456	182,335	306,456	182,335
Massachusetts	(3)	(3)	(3)	(3)	93,845	71,836
Michigan	(3)	(3)	(3)	(3)	1,141,848	787,861
Minnesota	(3)	(3)	(3)	(3)	48,199	40,788
Mississippi	(3)	(3)	(3)	(3)	245,209	202,378
Missouri	(3)	(3)	(3)	(3)	515,897	334,482
Montana			30,777	26,010	30,777	26,010
Nebraska			129,646	111,169	129,646	111,169
New Hampshire			18,108	12,381	18,108	12,381
New Jersey	(3)	(3)	(3)	(3)	234,586	255,247
New Mexico	(3)	(3)	(3)	(3)	37,787	39,240
New York	(4)	(3)	(3)	(3)	1,137,105	840,143
North Carolina			889,382	759,238	889,382	759,238
Ohio	26,732	8,020	1,681,371	1,336,644	1,708,103	1,344,664
Oklahoma	(3)	(3)	(3)	(3)	488,943	357,917
Oregon	(3)	(3)	(3)	(3)	111,208	77,470
Pennsylvania	11,497	17,095	1,586,730	1,371,470	1,598,227	1,388,565
South Carolina			342,778	292,584	342,778	292,584
Tennessee	(3)	(3)	(3)	(3)	735,370	554,750
Texas	41,020	188,168	1,105,448	848,695	1,146,468	1,036,863
Utah			83,763	125,942	83,763	125,942
Virginia			317,690	231,636	317,690	231,636
Washington	(3)	(3)	(3)	(3)	164,145	113,459
West Virginia	(3)	(3)	(3)	(3)	241,111	153,849
Wisconsin	(3)	(3)	(3)	(3)	154,913	135,207
Wyoming			20,305	14,619	20,305	14,619
Undistributed [5]	351,870	408,997	7,058,965	5,071,207	222,252	135,375
	806,899	1,447,673	19,383,445	14,574,339	20,190,344	16,022,012

[1] Includes the following: 1945—slip clay from Michigan and New York, 2,958 tons, $32,859; 1946—slip clay from Michigan, New York, and Pennsylvania, 3,384 tons, $36,184. Purchases of common clay and shale by cement companies: 1945—348,073 tons, $261,055 (estimated); 1946—438,335 tons, $328,751 (estimated).

[2] Includes the following: 1945—Common clay and shale used by producer in cement manufacture, 2,796,474 tons, $1,398,240 (estimated); 1946—4,334,575 tons, $2,167,288 (estimated).

[3] Included with "Undistributed."

[4] Figures include District of Columbia, Florida, Idaho, Maine, Minnesota, North Dakota, Puerto Rico, South Dakota, Vermont, Wyoming, and States indicated by footnote 3.

[5] Figures include Delaware, District of Columbia, Nevada, North Dakota, Puerto Rico, South Dakota, Vermont, and States indicated by footnote 3.

CLAY PRODUCTS

The long-heralded building boom became a reality in 1946, and for the first time in many years the clay-products industry was prosperous. As shown in the accompanying table, the output of many products nearly doubled. Prices advanced rapidly, and demand was so high that buyers often were willing to pay a premium over list to obtain delivery. As the unsatisfied need and available purchasing power appeared to be sufficient to maintain demand at a high level for several years, old plants were brought into production as rapidly as possible, and new capacity was added. Total output of structural clay products, according to reports of the Bureau of the Census, was valued at about $179,000,000.

During the past year, many people have become interested in entering the clay-products industry. Of interest to such people is a booklet, recently issued by the United States Department of Commerce, outlining technical practices and economic conditions in the industry.[2]

Quantity and value of shipments of the principal classes of structural clay products in the United States, 1944–46 [1]

	1944		1945		1946	
	Quantity	Value	Quantity	Value	Quantity	Value
Unglazed brick.....M brick..	2,004,110	$28,783,000	2,372,477	$39,149,000	4,643,787	$91,926,000
Glazed brick.....do....	2,333	82,000	3,630	151,000	(2)	(2)
Unglazed hollow facing tile....do....	92,401	1,931,000	98,654	2,272,000	100,966	2,711,000
Glazed hollow facing tile.....do....	80,668	3,176,000	92,651	3,856,000	171,866	8,052,000
Vitrified paving brick.....do....	21,889	654,000	22,557	694,000	25,376	833,000
Unglazed structural tile..short tons..	800,146	5,709,000	798,445	6,400,000	1,243,661	11,490,000
Vitrified-clay sewer pipe.....do....	781,829	17,387,000	776,417	18,332,000	1,077,584	30,288,000

[1] Compiled from information furnished by the Bureau of the Census, U. S. Department of Commerce.
[2] Figure not available.

During the war years, the production of refractories rose to record levels and then declined somewhat. However, during the past year the down trend was reversed as the metal, glass, and other industries that use high-temperature equipment operated near-capacity rates. The accompanying tables show statistics, compiled in part by the Bureau of Mines and in part by the Bureau of the Census, of refractories production for 1941–46.

[2] U. S. Department of Commerce, Manufacturing Brick and Tile to Serve Your Community: Industrial Series 49, 1946, 59 pp.

Production, shipments, and stocks of refractories in the United States, 1941–44, by kinds

[Value in thousands of dollars]

Product	Shipments						1944				
	1941		1942		1943		Stocks January 1	Production	Shipments		Stocks Dec. 31
	Quantity	Value	Quantity	Value	Quantity	Value			Quantity	Value	
Brick and shapes:											
Fire-clay refractories not reported elsewhere, 1,000 9-in. equiv.	721,201	38,878	832,789	49,419	720,622	44,042	176,465	529,342	547,501	32,134	154,071
Superduty fire-clay refractories, do.	60,982	4,579	77,746	6,483	73,548	6,471	15,371	69,982	70,119	5,968	15,216
High-alumina refractories (50 percent Al_2O_3 or over), 1,000 9-in. equiv.	19,059	2,864	21,818	3,459	27,967	4,056	4,429	24,079	23,668	3,363	5,111
Insulating refractories, do.	29,152	3,099	44,599	4,290	32,813	3,220	4,870	16,073	18,167	1,834	3,222
Sleeves, nozzles, runner brick, and tuyères, do.	45,367	3,923	50,145	4,527	49,579	4,341	9,029	43,718	45,330	4,247	7,376
Ladle and hot-top refractories, do.	234,389	8,768	230,173	9,226	230,493	9,202	22,628	212,529	211,227	8,214	22,657
Silica refractories, do.	310,680	19,962	344,757	24,112	320,329	21,821	65,761	281,722	288,259	18,673	56,870
Basic refractories (chrome and magnesite), do.	45,140	15,049	49,567	17,144	51,146	17,638	6,966	46,355	47,645	16,375	5,388
Glasshouse tank blocks, upper structure, and floaters, short tons	33,587	2,796	33,290	2,954	27,776	2,510	10,652	28,751	27,569	2,536	11,031
Glasshouse pots (open and covered), do.	2,596	269	2,256	240	2,011	231	1,024	2,526	2,646	324	734
Other refractory brick and shapes (fused alumina, kyanite, forsterite, silicon carbide, zircon, etc.)	(1)	13,250	(1)	14,886	(1)	15,637	(1)	(1)	(1)	14,069	(1)
Other refractories:											
Refractory bonding mortars:											
Ground fire clay, short tons	682,505	2,623	703,948	2,906	715,662	2,896	15,293	640,292	642,163	2,852	7,204
Ground silica clay, do.	48,273	417	61,984	570	65,180	600	139	49,785	49,660	427	165
High-temperature bonding mortars, do.	80,067	5,127	104,623	6,587	113,386	7,109	4,573	110,749	110,950	6,799	4,310
Other mortars, do.	22,892	591	30,340	945	33,385	1,090	336	27,656	27,134	878	858
Plastic refractories, including ramming mixtures, do.	66,810	2,858	86,094	3,861	91,869	4,139	4,529	116,471	117,682	4,349	3,452
Cast and castables, do.	27,626	1,421	31,883	1,718	38,906	2,129	3,267	32,046	34,228	1,946	1,584
Refractories (other than brick and shapes) not included above, short tons	488,985	7,582	472,621	7,936	500,211	8,579	5,632	510,147	517,071	8,235	7,669

[1] Figure not available.

Production and shipments of refractories in the United States, by kind, in 1945

[Bureau of the Census]

Product	Number of plants	Unit of measure	Production (quantity)	Shipments	
				Quantity	Value ($1,000's)
Clay and nonclay refractories, total	275				136,561
Clay refractories, total	213				67,775
Fire-clay brick and standard shapes except superduty.	118	1,000 9-in. equiv.	514,040	532,254	32,732
Superduty fire-clay brick and standard shapes.	27	do	64,719	68,651	5,852
High-alumina brick and shapes (50 percent Al_2O_3 and over, except fused alumina).	13	do	15,716	16,292	2,523
Insulating fire brick, standards, and special shapes.	13	do	16,877	17,740	1,948
Ladle brick	21	do	156,184	157,723	5,065
Hot-top refractories	17	do	48,407	48,949	3,050
Sleeves, nozzles, runner brick, and tuyères	18	do	55,543	55,399	3,825
Glasshouse tank blocks, upper structure, and floaters.	6	Short ton	21,359	21,593	1,835
Glasshouse pots (open and covered)	4	do	2,171	2,151	291
High-temperature bonding mortars	58	do	63,067	62,036	3,426
Plastic refractories	47	do	79,676	80,109	2,744
Cast and castables (hydraulic setting)	33	do	34,695	34,906	1,566
Other clay refractories, including kiln furniture and laboratory refractories (except porcelain).	47	do	77,063	77,739	2,918
Nonclay refractories, total	89				68,786
Silica brick and shapes	28	1,000 9-in. equiv.	266,033	270,830	18,476
Magnesite and magnesite-chrome brick and shapes.	4	do	16,691	16,642	6,405
Chrome and chrome-magnesite brick and shapes.	4	do	30,537	30,384	9,688
Graphite and other carbon crucibles and retorts.	8	Short ton	12,837	12,781	5,288
Other graphite and carbon refractories	3	do	1,281	1,291	497
Kiln furniture (saggers, posts and slabs, etc)	7	do	4,738	4,841	1,601
Laboratory refractories (muffles, crucibles, tubes, trays, etc.).	4	do	197	198	286
Other nonclay brick and shapes (of such material as silicon carbide, fused alumina, sillimanite, mullite, kyanite, forsterite, and zirconia).	16				7,091
High-temperature bonding mortars	20	Short ton	26,018	26,052	1,431
Plastic refractories (including ramming mixtures).	15	do	89,088	88,930	4,358
Cast and castables (hydraulic setting)	8	do	4,888	4,855	91
Dead-burned dolomite [2]	17	do		1,187,334	10,614
Nonclay refractory materials, sold in lump or ground form except dead-burned magnesia or magnesite.	16	do	66,840	66,325	2,169
Other nonclay refractories	11	do	8,644	8,896	791

[1] Data revised. Data are excluded for dead-burned magnesia or magnesite to avoid duplication; a large part of such materials was shipped during 1945 to refractory-products manufacturing plants and was later incorporated in the refractory products covered in this report (such as magnesite brick and shapes). Data are also excluded for crude and prepared clays sold for refractory purposes.

[2] Represents dead-burned dolomite sold in 1945, as reported by the Bureau of Mines.

Production, shipments, and stocks of refractories in the United States, by kind, in 1946 [1]

[Bureau of the Census]

Product	Number of plants	Unit of measure	Stocks at beginning of 1946 (quantity)	Production (quantity)	Shipments		Stocks at end of 1946 (quantity)
					Quantity	Value ($1,000's)	
Clay and nonclay refractories, total	265					153,304	
Clay refractories, total	207					81,464	
Fire-clay brick, standards and special shapes, except superduty.	123	1,000 9-in. equiv.	121,629	602,892	592,561	41,806	130,979
Superduty fire-clay brick, standards and special shapes.	23	do	12,762	53,738	53,798	5,571	12,702
High-alumina brick, standards and special shapes (50 percent Al_2O_3 and over, except fused alumina).	14	do	3,828	19,383	19,177	3,373	4,034
Insulating fire brick, standards and special shapes.	13	do	2,592	25,564	24,950	3,015	3,206
Ladle brick [2]	18	do	12,337	155,311	153,327	5,609	13,907
Hot-top refractories	12	do	3,998	26,255	26,194	2,060	4,059
Sleeves, nozzles, runner brick, and tuyères.	18	do	6,601	43,134	44,060	3,607	5,642
Glasshouse pots, tank blocks, upper structure, and floaters.	7	Short ton	10,277	27,385	26,016	2,692	11,646
High-temperature bonding mortars.	50	do	3,145	59,524	59,316	3,562	3,361
Plastic refractories (including ramming mixes).	47	do	3,234	84,331	84,126	2,960	3,225
Cast and castables (hydraulic setting).	42	do	1,845	47,435	46,858	2,198	2,307
Ground crude fire-clay and high-alumina refractories.	87	do		360,193	359,893	2,239	
Other clay refractories [3]	11					2,772	
Nonclay refractories, total	91					71,840	
Silica brick and shapes	32	1,000 9-in. equiv.	51,825	261,768	246,621	19,378	66,970
Magnesite and magnesite-chrome brick and shapes.	5	do	3,093	16,095	16,751	6,441	2,424
Chrome and chrome-magnesite brick and shapes.	5	do	2,560	28,929	28,755	9,348	2,534
Graphite and other carbon crucibles and retorts.	9	Short ton	1,234	11,476	11,545	4,861	1,153
Other graphite and carbon refractories.	3	do	186	1,091	1,121	411	198
Other nonclay brick and shapes (of such materials as silicon carbide, fused alumina, fused magnesia, mullite, kyanite, sillimanite, zirconia, and forsterite).	23					12,117	
High-temperature bonding mortars.	18	Short ton	606	18,516	18,380	1,482	749
Plastic refractories (including ramming mixtures).	21	do	1,427	55,131	55,195	3,155	1,390
Cast and castables (hydraulic setting).	7	do	23	2,380	2,303	133	100
Dead-burned dolomite [4]	18	do			1,077,983	10,102	
Other nonclay refractories	24	do		142,797	143,517	4,412	

[1] Data are excluded for dead-burned magnesia or magnesite to avoid duplication; a large part of such materials was shipped during 1946 to refractory-products manufacturing plants and was later incorporated in the refractory products covered in this report (such as magnesite brick and shapes). Data are also excluded for crude and prepared clays sold for refractory purposes.

[2] Up to 7 percent of the totals shown for this product were estimated on the basis of 1945 reports for 2 plants that reported incomplete data for 1946.

[3] Represents principally special shapes such as radiants, backwalls, and other shapes which were not reported in terms of 9-inch equivalent.

[4] Represents dead-burned dolomite sold in 1946, as reported by the Bureau of Mines.

TECHNOLOGIC DEVELOPMENTS

Between the nineteen twenties and the end of the war the heavy-clay-products industry was depressed by low volume, excess capacity, and low prices. Under these conditions the funds necessary to maintain adequately production equipment and improve it were seldom available. Consequently, some of the equipment and methods became obsolete. However, many operators made an effort to revamp their plants in preparing for the expected construction boom, and when it became certain that the boom was materializing the movement became general. The adoption of more efficient and labor-saving equipment was stimulated by the shortage of labor and high wages in 1946. Prominent among the equipment used in modernizing plant operations are: Fork trucks, tunnel kilns, improved driers, and conveyor belts.

An account of the improvement in the methods of producing dinnerware was published in 1946.[3]

Lightweight aggregates, which have been made of bloated clay for many years, are attracting increasing attention. The demand for lightweight aggregates, especially for use in concrete block, has multiplied since the war. Clays vary widely in bloating characteristics; consequently, many promising market areas must be neglected for lack of suitable raw material. Obviously, the discovery of a suitable admixture and technique that would allow the use of any clay would be a fundamental advance in the technology of this industry. Research projects with this object in view are now in progress.

During the war considerable progress was made in developing processes that will extract alumina from clay; some of them were tried out in plants of commercial size. By 1946, however, these processes were not yet able to compete commercially with the older methods using bauxite; and, as the wartime desire for self-sufficiency was no longer a strong influence, the Government owned alumina-from-clay plants were closed.

[3] Lund, M. S., Dinnerware Manufacturing, Past and Present: Ohio State University, Eng. Exper. Sta. News, October 1946, pp. 3-10.

Coal—Bituminous and Lignite[1]

By W. H. YOUNG, R. L. ANDERSON, AND L. H. ISAAC

	PAGE
Survey of the bituminous-coal and lignite industry in 1946	264
Sources of data	267
Salient statistics	269
Production by weeks and months	270
Average value by States	273
Consumption	273
Fuel efficiency	274
Relative rate of growth of coal, oil, and water power	275
Distribution	280
Stocks held by consumers	282
Final bituminous-coal and lignite statistics for 1945	283
Salient trends (historical data)	284
Summary by States and districts	290
Production by weeks and months	294
Number and size of mines	296
Average value	298
Final bituminous-coal and lignite statistics for 1945—Continued	
Labor statistics	299
Bituminous coal and lignite loaded for shipment by individual railroads and waterways	301
Methods of recovery	305
Stripping operations	307
Power drilling	314
Mechanical loading	315
Mechanical cleaning	320
Detailed statistics, by States and counties	325
Statistics on lignite in 1945	340
Production	340
Methods of recovery	342
Number and size of mines	342
Stripping operations	342
Imports and exports	343
World production	346

SURVEY OF THE BITUMINOUS-COAL AND LIGNITE INDUSTRY IN 1946

THE production of soft coal in 1946—an estimated output of 532,000,000 net tons [2]—declined 8 percent from the 577,617,327 tons produced in 1945. This decline was not due to lower demand but to strikes. The soft-coal industry suffered two major strikes in 1946 and intermittent wildcat strikes throughout the entire year. The estimated loss of production during the two major strikes alone amounted to 107,000,000 tons. According to the Bureau of Labor

[1] Data for 1946 are preliminary; detailed statistics with final revisions will be released later. Data for 1945 are final.

[2] Throughout this chapter, "tons" refers to net tons of 2,000 pounds, unless otherwise indicated.

Statistics, there were 485 strikes in soft-coal mines in 1946, with 834,000 workers involved and 19,500,000 man-days lost (an average of 23 days per man). Although the war was over, the shortage of coal continued and Government controls were retained.

Production.—There was practically no seasonal decline in production in 1946, due to the shortage of coal. Throughout most of the year production was over 12,000,000 tons per week, except when output was reduced because of strikes or holidays.

Consumption.—All major classes of consumers except cement mills used less coal in 1946 than in 1945. The total consumption in 1946 was approximately 59,000,000 tons less than in 1945. Table 5 shows trends in consumption for the major classes of consumers.

Changes in Stocks.—The reserve supply of bituminous coal and lignite in the hands of industrial consumers and retail coal yards increased from 45,665,000 tons at the beginning of 1946 to 47,157,000 tons at the close. The days' supply of stocks increased from 27 to 32. Stocks on the upper Lake docks increased 530,587 tons from January 1 to December 31, 1946.

Distribution.—Shipments of bituminous coal and lignite during 1946 decreased in most distribution channels compared with 1945. Table 10 shows trends in distribution of bituminous coal and lignite for 1940–46. Changes in the monthly volume of the more important movements are shown in figure 9.

Mechanization.—The quantity of coal loaded mechanically at underground mines in the United States continued to advance during 1946. Mechanical loading increased from 56 percent of the total underground output in 1945 to an estimated 58 percent in 1946. Sales of underground loading equipment, in terms of capacity, were 20 percent greater in 1946 than in 1945.

Mechanical Cleaning.—The total capacity of mechanical-cleaning equipment sold for use at bituminous-coal mines in 1946 was estimated at 18,000 tons of cleaned coal per hour, an increase of 78 percent over the previous year.

Trend of Employment.—The average number of men employed at bituminous-coal and lignite mines in 1946 increased to 405,000 men from 383,100 in 1945.

Index to Capacity.—The potential output upon a 308-day basis (6-day week, full-time capacity) was 682,000,000 tons in 1945. Since it is not possible for all mines to operate 308 days per year, the more conservative figure of 280 days was suggested some years ago by the coal committee of the American Institute of Mining and Metallurgical Engineers (see Minerals Yearbook, 1935, pp. 631–632). The average output per day worked in 1945 was 2,213,093 tons, which (if applied to 280 days) gives an annual potential output of 620,000,000 tons compared with the actual total production of 577,617,327 tons. For purposes of historical comparison, a capacity of 261 days, based on the 5-day week, is also shown in figure 4 and table 14.

Trend of Fuel Efficiency.—For many years before 1942 there was a steady trend toward increased fuel efficiency. During the period 1942–46 the various components of this trend were arrested or reversed. All industries shown in table 6 exhibited decreased fuel efficiency in 1946 compared to 1945 except electric public-utility power plants, which reported no change.

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Competition with Oil and Gas.—Soon after the close of the war, increased competition between the fuels developed, with numerous reports of conversion from coal to fuel oil.

Electric power utilities consumed 4 percent less bituminous coal, 79 percent more fuel oil, and 6 percent less gas in 1946 than in 1945.

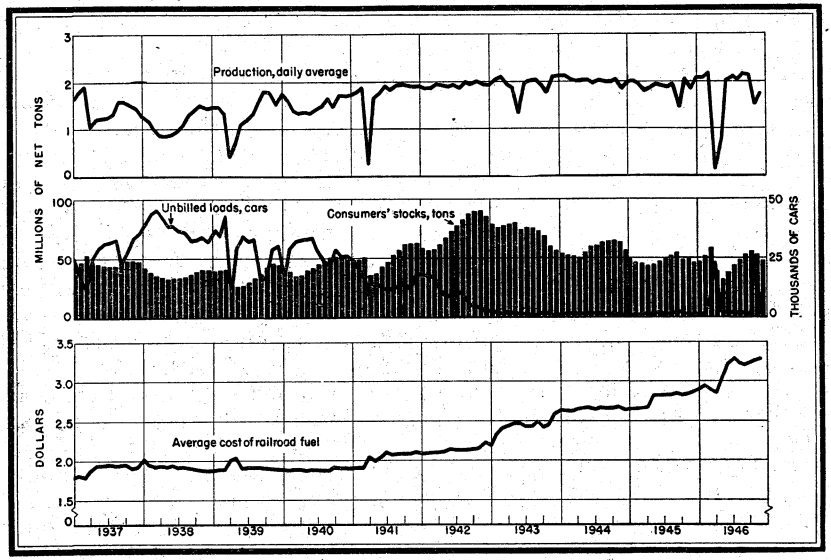

FIGURE 1.—Trends of production, stocks, and prices of bituminous coal and lignite in the United States, 1937-46.

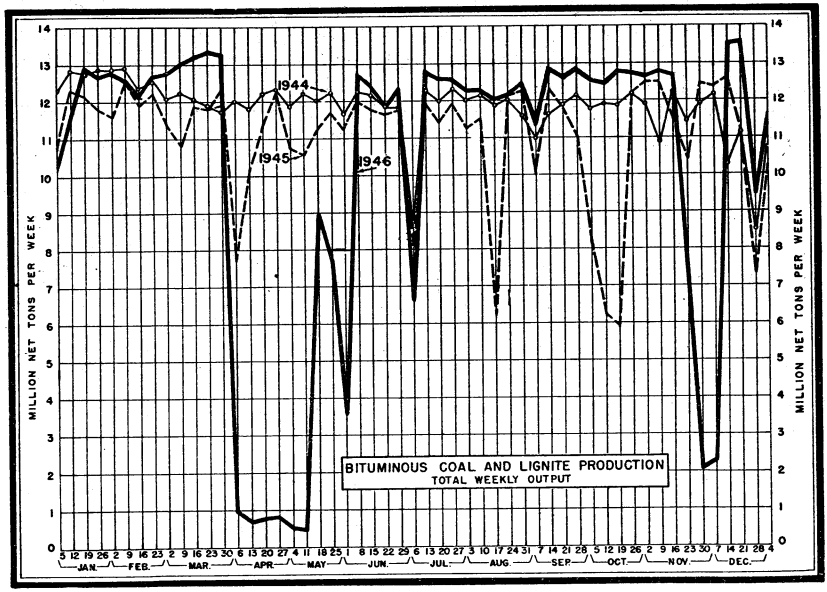

FIGURE 2.—Production of bituminous coal and lignite in the United States, by weeks, 1944-46.

Class I railroads decreased their consumption of coal 12 percent in 1946, and their purchases of fuel oil decreased from 1945 purchases by the same proportion.

The manufacture of domestic coal-burning equipment is reflected in statistics published by the Bureau of the Census. Factory sales of domestic stokers for burning bituminous coal increased from 89,522 in 1945 to 164,304 in 1946. Shipments of domestic oil burners, boiler-burner units, and furnace-burner units increased from 139,611 in 1945 to 499,009 in 1946.

SOURCES OF DATA

Bituminous-coal- and lignite-production statistics for 1946 are preliminary estimates based upon (1) weekly or monthly reports of railroad carloadings of coal and beehive coke by all the important carriers, (2) shipments by river as reported by the United States Army Engineers, (3) direct reports from a number of mining companies, and (4) monthly production statements compiled by a number of local operators' associations and State mine departments. In the estimates for 1946, allowance has been made for commercial truck shipments, local sales and colliery fuel, and small trucking or wagon mines producing over 1,000 tons a year.

Data for 1945 are final and are based upon detailed annual reports of production and mine operation furnished by the producers. As in previous years, all but a small percentage of the output was covered by the reports submitted. For the remaining output not directly reported—consisting chiefly of small mines—it has been possible to obtain reasonably accurate data from the records of the State mine departments, which have statutory authority to require such reports, or in a few instances from railroad carloadings.

Final employment figures obtained from the annual canvass of production, as shown in this report for 1945, differ slightly from the estimated total of employment based on the monthly canvass of accidents at mines accounting for approximately 75 percent of the total bituminous-coal output, as published in the chapter from Minerals Yearbook, 1945, entitled "Employment and Injuries in the Mineral Industries." According to the annual canvass, the average number of men employed amounted to 383,100, whereas the monthly canvass indicated that the total average number working was 363,000. The major cause of this slight discrepancy was that the figure determined by the annual canvass represented the average number of men on the rolls per pay period while the other represented the average of men working daily.

In accordance with the practice followed by the Bureau of Mines in previous years, the statistics in this report relate to mines having an output of 1,000 tons a year or more and do not attempt to include the many small mines producing less than 1,000 tons a year that sell their output by wagon or truck.

These data include, for convenience and historical comparison, the small output of anthracite and semi-anthracite produced outside Pennsylvania and the production of lignite.

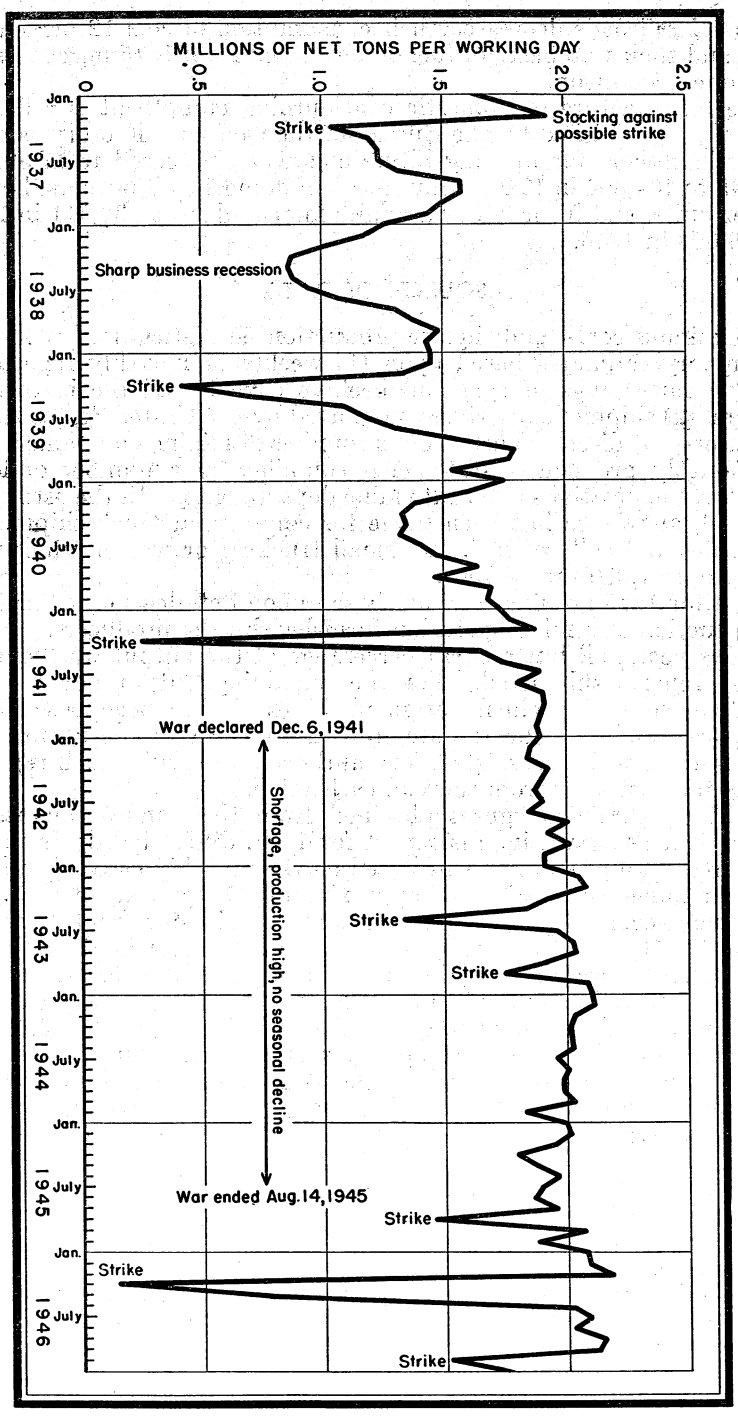

FIGURE 3.—Average production of bituminous coal and lignite in the United States per working day in each month, 1937–46.

SALIENT STATISTICS

TABLE 1.—Salient statistics of the bituminous-coal and lignite industry in the United States, 1945–46

[All tonnage figures represent net tons]

	1945	1946 (preliminary)	Change in 1946
			Percent
Production	577,617,327	532,000,000	−7.9
Consumption in the United States [1]	559,567,000	500,352,000	−10.6
Stocks at end of year:			
Industrial consumers and retail yards	45,665,000	47,157,000	+3.3
Stocks on upper Lake docks	5,049,242	5,579,829	+10.5
Unbilled loads, at mines or in classification yards [2]	37,050	46,200	+24.7
Price indicators (average per net ton):			*Cents*
Average cost of railroad fuel purchased, f. o. b. mines [3]	$2.78	$3.11	+33
Average cost of coking coal at merchant byproduct ovens [4]	$5.90	$6.48	+58
Average retail price—35 cities [5]	$10.49	$10.95	+46
Average railroad freight charge per net ton [6]	$2.20	$2.26	+6
Underground loading machinery sold: [7]			*Percent*
Mobile loading machines (number)	349	490	+40.4
Scrapers (number)	6	3	−50.0
Conveyors, including those with duckbills (units)	738	838	+13.6
"Mother" conveyors (units)	137	183	+33.6
Surface stripping	109,986,865	109,000,000	−.9
Mechanically loaded underground	262,512,729	246,000,000	−6.3
Mechanically cleaned	147,885,936	140,000,000	−5.3
Average number of men employed at mines operating [8]	383,100	405,000	+5.7
Fuel efficiency indicators:			
Pounds of coal per kw.-hr. at electric power plants [9]	1.30	1.30	
Pounds per 1,000 gross ton-miles—railroads [10]	116	116	

[1] Represents certain classes of consumers only. See table 5 for consumers included.
[2] Association of American Railroads.
[3] Interstate Commerce Commission (class I steam railways, including class I switching and terminal companies). Excludes freight charges.
[4] As reported by coke operators.
[5] Bureau of Labor Statistics, U. S. Dept. of Labor.
[6] Average receipts per net ton of revenue bituminous coal and lignite originated, as reported by the Interstate Commerce Commission.
[7] Young, W. H., and Anderson, R. L., Sales of Mechanical Loading and Cleaning Equipment: Coal Age, February 1947, pp. 89–91, and Min. Cong. Jour., February 1947, pp. 44–46.
[8] The figure for 1945 is based upon reports of mine operators producing over 1,000 tons. The figure for 1946 is estimated from various sources.
[9] Federal Power Commission.
[10] Interstate Commerce Commission; includes coalequivalent of fuel oil consumed.

PRODUCTION BY WEEKS AND MONTHS

The following tables summarize the preliminary statistics of weekly and monthly production of bituminous coal and lignite in 1946. The figures are estimates based upon daily and weekly statements of cars of coal and beehive coke loaded by the principal railroads and of shipments over the more important originating rivers. Allowance has been made for commercial truck shipments, local sales, and colliery fuel. The estimates given are based upon the latest information available and differ in some instances from the current figures previously published in the Weekly Coal Reports.

For the method used in counting holidays, see the chapter on Coal in Mineral Resources of the United States, 1930, page 631.

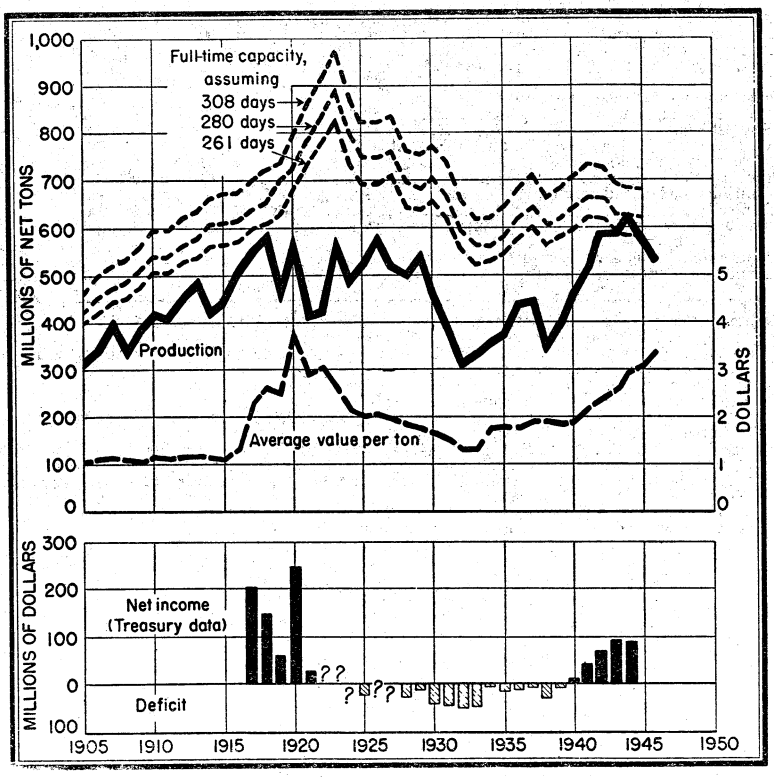

FIGURE 4.—Trends of bituminous-coal and lignite production, realization, mine capacity, and net income or deficit in the United States, 1905–1946.

TABLE 2.—Estimated weekly production of bituminous coal and lignite in the United States in 1946

Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)	Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)
Jan. 5	[1] 8,546,000	[1] 4.1	[2] 2,012,000	July 6	6,667,000	3.5	1,905,000
12	11,670,000	6	1,945,000	13	12,865,000	6	2,144,000
19	12,929,000	6	2,155,000	20	12,596,000	6	2,099,000
26	12,640,000	6	2,107,000	27	12,603,000	6	2,101,000
Feb. 2	12,743,000	6	2,124,000	Aug. 3	12,310,000	6	2,052,000
9	12,592,000	6	2,099,000	10	12,312,000	6	2,052,000
16	12,153,000	6	2,026,000	17	12,013,000	6	2,002,000
23	12,660,000	6	2,110,000	24	12,154,000	6	2,026,000
Mar. 2	12,732,000	6	2,122,000	31	12,516,000	6	2,086,000
9	13,058,000	6	2,176,000	Sept. 7	11,326,000	5.1	2,221,000
16	13,215,000	6	2,203,000	14	12,888,000	6	2,148,000
23	13,310,000	6	2,218,000	21	12,624,000	6	2,104,000
30	13,282,000	6	2,214,000	28	12,864,000	6	2,144,000
Apr. 6	938,000	5	188,000	Oct. 5	12,551,000	6	2,092,000
13	716,000	6	119,000	12	12,518,000	6	2,086,000
20	773,000	6	129,000	19	12,787,000	6	2,131,000
27	824,000	6	137,000	26	12,760,000	6	2,127,000
May 4	545,000	6	91,000	Nov. 2	12,658,000	6	2,110,000
11	463,000	6	77,000	9	12,732,000	6	2,122,000
18	8,955,000	6	1,493,000	16	12,643,000	5.7	2,218,000
25	7,672,000	6	1,279,000	23	6,519,000	6	1,087,000
June 1	3,589,000	5	718,000	30	2,038,000	5	408,000
8	12,742,000	6	2,124,000	Dec. 7	2,308,000	6	385,000
15	12,368,000	6	2,061,000	14	13,607,000	6	2,268,000
22	11,872,000	6	1,979,000	21	13,634,000	6	2,272,000
29	12,323,000	6	2,054,000	28	9,508,000	5	1,902,000
				Jan. 4, 1947	[1] 4,689,000	[1] 2	[2] 2,253,000
					532,000,000	304.4	1,748,000

[1] Figures represent output and number of working days in that part of week included in calendar year shown. Total production for week ended January 5, 1946, was 10,263,000 net tons; week ended January 4, 1947, 11,489,000 net tons.

[2] Average daily production for entire week and not for working days in calendar year shown.

TABLE 3.—Estimated monthly production of bituminous coal and lignite in the United States, by States, and number of working days and average production per day in 1946

[Production figures in thousands of net tons]

[Bituminous-coal and lignite figures are preliminary estimates based on railroad carloadings and river shipments of coal and beehive coke, supplemented by direct reports from a number of mining companies, local coal operators' associations, and detailed monthly production statistics compiled by the State Mine Departments of Colorado, Illinois, Pennsylvania, Washington, and West Virginia. In making the estimates, allowance is made for commercial truck shipments, local sales, and colliery fuel, and for small trucking mines producing over 1,000 tons a year. The estimates here given differ in a few cases from the monthly figures previously published in the Weekly Coal Reports]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
Alabama	1,480	1,367	1,870	130	578	1,655	1,653	1,658	1,527	1,683	1,024	1,155	15,780
Alaska	28	27	27	28	25	23	26	30	38	44	39	33	368
Arkansas	170	145	156	46	48	108	134	150	142	171	126	144	1,540
Colorado	782	662	690	20	243	382	352	450	560	695	465	614	5,915
Georgia and North Carolina	3	2	3	1	1	4	3	4	4	4	3	3	35
Illinois	6,710	6,188	6,870	1,207	2,542	5,808	5,491	6,138	5,848	6,660	4,010	5,082	62,554
Indiana	2,380	2,114	2,390	118	883	2,005	2,100	1,885	2,163	2,522	1,425	1,833	21,818
Iowa	175	162	156	57	92	130	117	133	126	134	128	144	1,554
Kansas and Missouri	597	565	640	185	328	452	522	565	566	568	427	475	5,890
Kentucky:													
Eastern	4,600	4,605	5,120	194	1,704	4,615	4,838	5,300	4,785	5,340	3,095	3,644	47,840
Western	2,013	1,841	2,068	91	645	1,706	1,868	1,808	1,787	1,895	1,498	1,696	18,916
Maryland	205	185	236	8	114	212	216	203	156	182	135	158	2,010
Michigan	11	11	15	2	6	14	13	12	10	6	4	4	108
Montana (bituminous and lignite)	413	365	340	166	230	293	278	275	343	402	315	380	3,800
New Mexico	130	106	132	5	65	121	112	122	118	132	90	117	1,250
North and South Dakota (lignite)	320	242	180	114	130	140	135	147	236	355	352	363	2,714
Ohio	3,350	2,940	3,435	270	1,300	3,230	3,160	3,175	2,982	3,755	2,426	2,825	32,848
Oklahoma	270	232	250	113	116	176	220	244	202	248	202	237	2,510
Pennsylvania (bituminous)	12,643	11,637	13,520	230	2,470	11,996	12,800	13,537	12,640	14,198	9,154	10,330	125,155
Tennessee	651	610	730	34	122	632	627	653	572	644	395	480	6,150
Texas (bituminous and lignite)	10	7	9	3	5	6	6	6	6	6	7	9	80
Utah	630	590	638	14	248	472	548	566	590	627	442	625	5,990
Virginia	1,645	1,585	1,762	32	705	1,705	1,590	1,770	1,542	1,730	1,032	1,202	16,300
Washington	120	110	118	6	22	94	86	91	85	106	75	77	990
West Virginia:													
Southern [1]	9,517	8,948	10,028	183	4,164	10,071	9,544	10,721	9,614	10,255	6,544	7,839	97,428
Northern [2]	4,598	4,170	4,608	223	2,546	4,084	4,298	4,305	4,533	4,218	3,436	3,613	44,632
Wyoming	980	830	856	25	362	444	612	736	745	903	650	662	7,805
Other Western States	2	2	2	1	1	1	1	2	2	2	2	2	20
Total	54,433	50,248	56,849	3,506	19,695	50,579	51,350	54,686	51,922	57,485	37,501	43,746	532,000
Days and average production:													
Number of working days	26.1	24.0	26.0	25.0	26.0	25.0	24.5	27.0	24.1	27.0	24.7	25.0	304.4
Average production per working day	2,086	2,094	2,187	140	758	2,023	2,096	2,025	2,154	2,129	1,518	1,750	1,748

[1] Includes operations on the N. & W., C. & O., Virginian, K. & M., B. C. & G., and on the B. & O. in Kanawha, Mason, and Clay Counties.
[2] Rest of State, including the Panhandle district and Grant, Mineral, and Tucker Counties.

AVERAGE VALUE BY STATES

TABLE 4.—Average value per ton, f. o. b. mines, of bituminous coal and lignite in the United States, by States, 1945–46 [1]

State	1945	1946 (preliminary)	State	1945	1946 (preliminary)
Alabama	$4.19	$4.60	North and South Dakota (lignite)	$1.56	$1.74
Alaska	6.28	6.41	Ohio	2.79	3.06
Arkansas	5.05	5.86	Oklahoma	3.61	3.78
Colorado	3.69	3.82	Pennsylvania	3.29	3.63
Georgia	3.85	4.60	Tennessee	3.43	3.83
Illinois	2.34	2.57	Texas (lignite)	.85	.85
Indiana	2.32	2.54	Utah	3.41	3.63
Iowa	3.51	3.59	Virginia	3.43	3.73
Kansas	2.57	2.82	Washington	5.12	5.52
Kentucky	3.00	3.24	West Virginia	3.20	3.66
Maryland	3.61	3.86	Wyoming	2.83	2.96
Michigan	5.47	6.44	Other States [2]	3.89	4.10
Missouri	2.59	2.82			
Montana (bituminous and lignite)	1.89	1.54	Total	3.06	3.40
New Mexico	3.80	4.16			

[1] Average gross realization; selling cost not deducted.
[2] Includes Arizona and Oregon.

CONSUMPTION

TABLE 5.—Consumption of bituminous coal and lignite, by consumer class, with retail deliveries in the United States, 1937–46, in thousands of net tons

Year	Colliery fuel	Electric power utilities [1]	Bunker, foreign trade [2]	Railroads (class I) [3]	Coke		Steel and rolling mills	Coal-gas retorts	Cement mills [4]	Other industrials [5]	Retail-dealer deliveries [6]	Total of classes shown
					Beehive ovens	By-product ovens						
1937	3,052	42,871	1,832	88,080	4,927	69,575	12,853	1,680	5,247	122,410	80,076	432,603
1938	2,493	38,245	1,352	73,921	1,360	45,266	8,412	1,644	4,483	92,390	68,520	338,086
1939	2,565	43,979	1,477	79,072	2,298	61,216	9,808	1,614	5,274	98,900	71,570	377,773
1940	2,443	50,973	1,426	85,130	4,803	76,583	10,040	1,746	5,633	106,280	87,700	432,757
1941	2,489	61,861	1,643	97,384	10,529	82,609	10,902	1,659	6,832	120,720	97,460	494,088
1942	2,708	65,636	1,585	115,410	12,876	87,974	10,434	1,721	7,570	131,550	104,750	542,214
1943	2,702	76,403	1,647	130,283	12,441	90,019	11,238	1,605	5,851	141,211	122,764	596,164
1944	2,712	78,887	1,559	132,049	10,858	94,438	10,734	1,545	3,789	130,353	124,906	591,830
1945	2,442	71,603	1,785	125,120	8,135	87,214	10,084	(6)	4,215	127,164	121,805	559,567
1946 [7]	2,250	68,739	1,381	110,166	6,821	76,178	8,603	(6)	6,969	118,659	100,586	500,352

[1] Federal Power Commission. Represents bituminous coal and lignite consumed by public-utility power plants in power generation, including a small quantity of coke amounting to approximately 100,000 tons annually.
[2] U. S. Bureau of Census.
[3] Association of American Railroads. Represents consumption of bituminous coal and lignite by class I railways for all uses, including locomotive, powerhouse, shop, and station fuel. The Interstate Commerce Commission reports that in 1945 consumption for all uses by class I line-haul railways, plus purchases for class II and class III railways, plus purchases by all switching and terminal companies combined, was 129,315,950 tons of bituminous coal and lignite. Similar data from the Interstate Commerce Commission are not yet available for 1946.
[4] Includes small amount of anthracite.
[5] Estimates based upon reports collected by the Solid Fuels Administration for War from a selected list of representative manufacturing plants and retail dealers. Truck shipments from mines included in "Retail dealer deliveries" in Minerals Yearbook, 1945, for the years 1939–45 have been restored to the classification "Other industrials" as in Minerals Yearbook, 1944, and preceding volumes.
[6] Included in "Other industrials."
[7] Subject to revision.

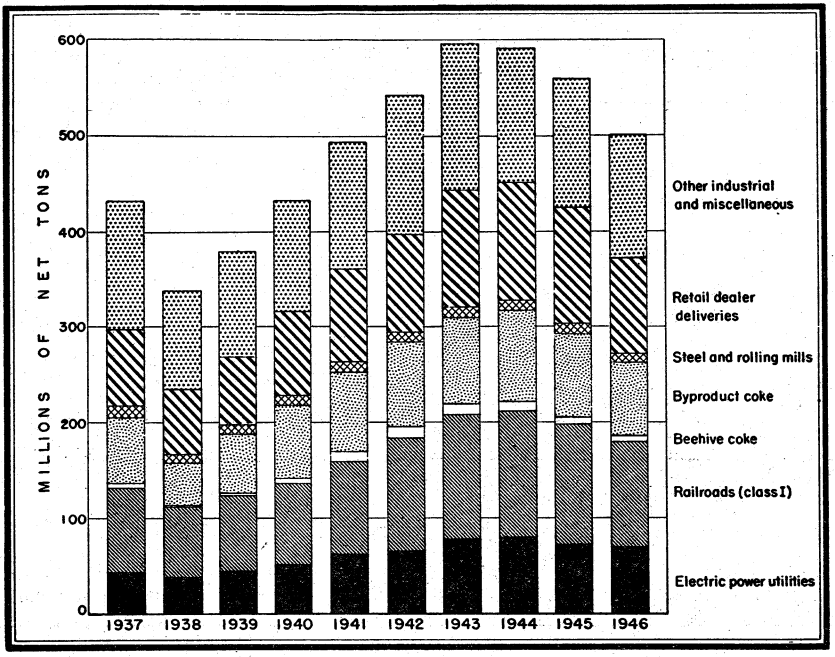

FIGURE 5.—Consumption of bituminous coal and lignite, by consumer class, with retail deliveries in the United States, 1937–46.

FUEL EFFICIENCY

TABLE 6.—Indicators of effect of fuel economy on consumption of coal in the United States per unit of performance since World War I

	Pounds	Reduction from base period (percent)
Steam railroads:		
Pounds per 1,000 gross ton-miles freight service:		
Average:		
1919–20	170	
1945	116	31.8
1946	116	31.8
Pounds per passenger-train car-mile:		
Average:		
1919–20	18.5	
1945	14.9	19.5
1946	15.2	17.8
Electric public-utility power plants:		
Pounds per kilowatt-hour:		
1919	3.2	
1945	1.3	59.4
1946	1.3	59.4
Iron and steel plants:		
Pounds coking coal per net ton of pig: [1]		
1918	3,194	
1945	2,656	16.8
1946	2,706	15.3
Coke manufacture: Savings of heat values through recovery of gas, tar, light oils, and breeze by extension of byproduct in place of beehive coking, 1913–14, expressed as percent of coal used for all coke in 1946 [2]		18.1

[1] Includes only savings through higher yields of merchantable coke per ton of coal charged and lower consumption of coke per ton of iron and ferro-alloys. Excludes economies through recovery of byproducts, which are covered in next item.

[2] These byproducts are used in part for boiler fuel, in part for metallurgical purposes, in part for domestic heating and cooking, and to a small extent for automotive fuel.

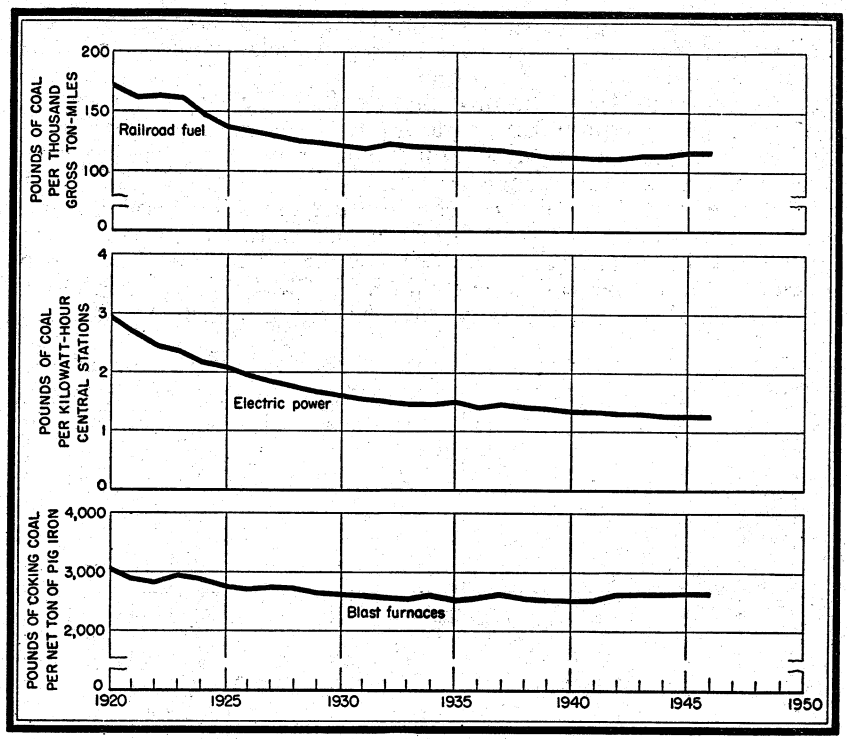

FIGURE 6.—Trends in fuel efficiency in the United States, 1920–46.

RELATIVE RATE OF GROWTH OF COAL, OIL, AND WATER POWER, 1889–1946

The total supply of available energy in the form of coal, oil, natural gas, and water power in 1946 was 35,977 trillion B.t.u.—an 0.4-percent increase over 1945 (see fig. 7).

The figures are expressed in British thermal units because some common denominator is necessary for such unlike quantities as tons of coal, barrels of oil, and cubic feet of gas. Table 7 summarizes the equivalent of each of the fuels in trillions of British thermal units. Water power is represented by the equivalent fuel required to perform the same work. The table covers the years since 1936. Details for 1889 and 1899 to 1935 are given in Minerals Yearbook, 1937, page 807, and Minerals Yearbook, 1938, page 703.

In converting water power to its fuel equivalent, two alternative assumptions have been made. The first, as in previous issues of these tables, assumes a *constant* fuel equivalent of 4.02 pounds of coal for each kilowatt-hour of water power produced throughout the entire period from 1889 to 1946. This factor was selected because it represents, in round numbers, the average efficiency of all central stations generating steam-electric power in 1913, the base period used. The usefulness of the *constant* factor lies in showing the rate at which water power is being developed. It permits direct comparison between the relative increase (in kilowatt-hours of water power) and the corresponding increase or decrease (in tons of coal, barrels of oil, or cubic

feet of gas produced). On the other hand, the *constant* factor makes no allowance for the fact that coal and other fuels produced today are used more efficiently than formerly.

To show the influence of improving fuel efficiency, a second computation of the energy equivalent of water power has therefore been made. This assumes a *prevailing* fuel equivalent, diminishing year by year, which represents the average performance of all fuel-burning central electric stations for the year in question. This average had declined from about 7.05 pounds of coal per kilowatt-hour in 1899 to 1.30 pounds in 1946. (The *prevailing* factor is thus much above the *constant* factor in 1899 and much below it in 1946). The *prevailing* fuel equivalent indicates more nearly the quantity of fuel that would have

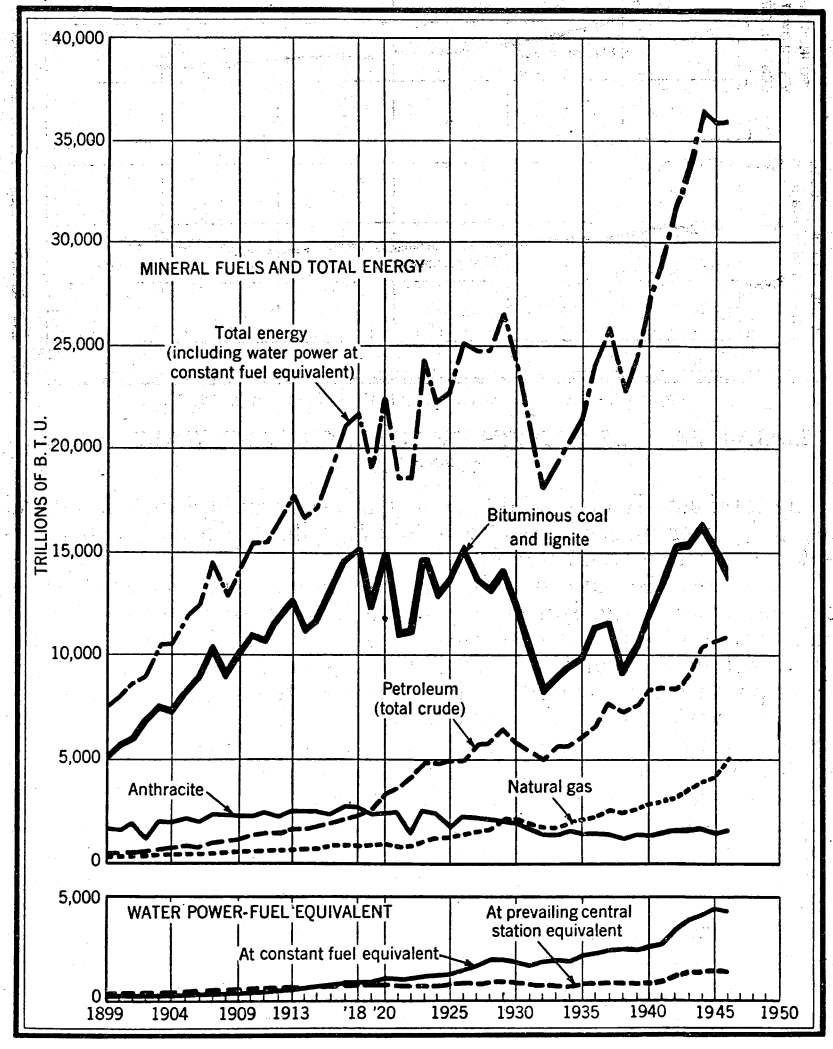

FIGURE 7.—Annual supply of energy from mineral fuels and water power in the United States, 1899–1946.

been needed in any one year to generate the same power in a steam-electric station. It should be noted, however, that the ultimate uses to which the water power generated is put often displace fuel burned much less efficiently than in central stations and that in any instance no other important branch of fuel consumption has made advances in fuel efficiency approaching that of the central stations.

As these tables attempt to determine the total energy from all fuels and from water power, the ideal factor for converting water power into fuel equivalent would be the average efficiency of all forms of fuel consumption in each year. No basis for determining such an all-embracing average exists at present, but enough is known to make certain that it would show much less reduction from 1899 to 1946 than do the central stations. For the present, a just comparison of the changing contributions of water power and of fuel to the national energy supply would lie somewhere between the results shown by the *constant* equivalent and the *prevailing* central-station equivalent in these tables.

As in earlier issues of these tables, the figures for oil and natural gas represent the entire production of crude petroleum and of gas. Most of this production does not come into direct competition with coal.

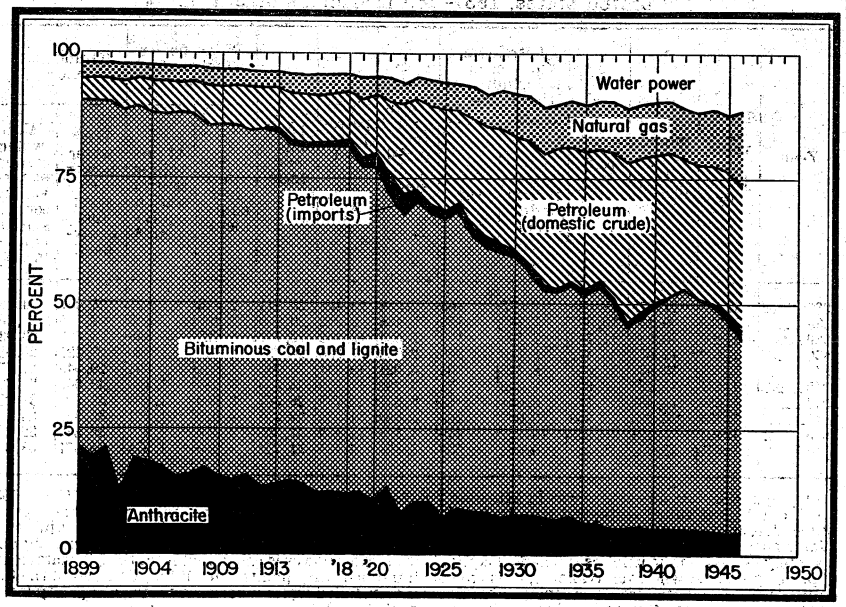

FIGURE 8.—Percentage of total B. t. u. equivalent contributed by the several sources of energy in the United States, counting water power at constant fuel equivalent, 1899–1946. If water power is counted at the prevailing fuel equivalent of central stations in each year, its proportion is 3.2 percent in 1899 and 4.2 percent in 1946, and the proportions of the other sources of energy are affected accordingly.

Much of the supply of both oil and gas is used in regions of the country, such as California and portions of the Southwest, where coal is available only at unusually high cost because of heavy transport charges. Nearly half of the natural gas is used in the field for drilling or operating oil and gas wells and pipe lines or for the manufacture of carbon black. More than half the oil is used in the form of gasoline, kerosine, and lubricants, for which purposes coal cannot well compete, except at very much higher levels of oil prices. Even these refined products, however, involve a certain measure of indirect competition with coal, for the energy market of the country is becoming more fluid and competitive, and a demand that cannot be met by one source of supply tends to fall back on the others.

The subject of interfuel competition is exceedingly complex, and an elaborate analysis and the accumulation of data not now available would be required to determine even approximately how much of any one fuel actually has been displaced either by other fuels or by water power. The present tables do not permit determination of such displacement; their purpose is rather to measure the long-time trends in the total demand for energy.

TABLE 7.—Annual supply of energy from mineral fuels and water power in the United States, 1937–46,[1] in trillions of B. t. u.[2]

Year	Pennsylvania anthracite	Bituminous coal and lignite	Total coal	Petroleum (total crude, including that refined)		Natural gas (total production)	Total petroleum and natural gas	Total mineral fuels	Water power (fuel equivalent)		Grand total energy	
				Domestic production	Imports				At constant fuel equivalent[3]	At prevailing central station equivalent[4]	With water power at constant fuel equivalent	With water power at prevailing central station equivalent
1937	1,410	11,673	13,083	7,675	165	2,588	10,428	23,511	2,446	871	25,957	24,382
1938	1,255	9,132	10,387	7,286	158	2,468	9,912	20,299	2,466	866	22,765	21,165
1939	1,400	10,345	11,745	7,590	199	2,663	10,452	22,197	2,423	838	24,620	23,035
1940	1,400	12,072	13,472	8,119	256	2,860	11,235	24,707	2,620	880	27,327	25,587
1941	1,533	13,471	15,004	8,413	304	3,024	11,741	26,745	2,804	934	29,549	27,679
1942	1,641	15,267	16,908	8,320	74	3,282	11,676	28,584	3,485	1,136	32,069	29,720
1943	1,650	15,463	17,113	9,034	83	3,671	12,788	29,901	3,999	1,304	33,900	31,205
1944	1,733	16,233	17,966	10,067	269	3,989	14,325	32,291	4,029	1,301	36,320	33,592
1945[5]	1,494	15,134	16,628	10,267	445	4,166	14,878	31,506	4,336	1,401	35,842	32,907
1946[5]	1,651	13,938	15,589	10,401	535	5,199	16,135	31,724	4,253	1,374	35,977	33,098

[1] Comparable data for earlier years in Minerals Yearbook, 1937, p. 807 and Minerals Yearbook, 1938, p. 703.

[2] The unit heat values employed are: Anthracite, 13,600 B. t. u. per pound; bituminous coal and lignite, 13,100 B. t. u. per pound; petroleum, 6,000,000 B. t. u. per barrel; natural gas, 1,075 B. t. u. per cubic foot. Water power includes installations owned by manufacturing plants and mines, as well as Government and privately owned public utilities. The fuel equivalent of water power is calculated from the kilowatt-hours of power produced wherever available, as is true of all public-utility plants since 1919. Otherwise, the fuel equivalent is calculated from the reported horsepower of installed water wheels, assuming a capacity factor of 20 percent for manufacturers and mines for the years 1936 to 1943.

[3] Assuming 4.02 pounds per kilowatt-hour, which is the average of central electric station practice in 1913, the base period used.

[4] Assuming the average central-station practice for each of the years for which data are available, which declined from about 7.05 pounds per kilowatt-hour in 1899 to 1.30 pounds in 1946.

[5] Subject to revision.

TABLE 8.—Index numbers for relative rate of growth of coal, oil, and water power in the United States, 1937–46 [1]

[Figures are expressed as percentage of 1918 rate]

Year	Pennsylvania anthracite	Bituminous coal and lignite	Total coal	Petroleum (total crude)		Natural gas (total production)	Total petroleum and natural gas	Total mineral fuels	Water power (at constant fuel equivalent)	Grand total	
				Domestic production	Imports					With water power at constant fuel equivalent	With water power at prevailing central station equivalent
1937	52	77	73	359	73	334	332	112	292	119	112
1938	47	60	58	341	70	318	316	97	295	104	98
1939	52	68	66	355	88	344	333	106	289	113	106
1940	52	80	75	380	113	369	358	118	313	125	118
1941	57	89	84	394	135	390	374	127	335	135	128
1942	61	101	95	390	33	423	372	136	416	147	137
1943	61	102	96	423	37	474	408	142	478	155	144
1944	64	107	101	471	119	515	457	154	481	166	155
1945 [2]	56	100	93	481	197	538	474	150	518	164	152
1946 [2]	61	92	87	487	237	671	514	151	508	165	152

[1] Comparable data for earlier years in Minerals Yearbook, 1937, p. 809 and Minerals Yearbook, 1938, p. 704.
[2] Subject to revision.

TABLE 9.—Percentage of total B. t. u. equivalent contributed by the several mineral fuels and water power in the United States, 1937–46 [1]

Year	Pennsylvania anthracite	Bituminous coal and lignite	Total coal	Petroleum (total crude)		Natural gas (total production)	Total petroleum and natural gas	Total mineral fuels	Water power, fuel equivalent	Grand total, including water power
				Domestic production	Imports					
	Water power counted at constant fuel equivalent of approximately 4 pounds per kilowatt-hour									
1937	5.4	45.0	50.4	29.6	0.6	10.0	40.2	90.6	9.4	100.0
1938	5.5	40.1	45.6	32.0	.7	10.8	43.5	89.1	10.9	100.0
1939	5.7	42.0	47.7	30.8	.8	10.8	42.4	90.1	9.9	100.0
1940	5.1	44.2	49.3	29.7	.9	10.5	41.1	90.4	9.6	100.0
1941	5.2	45.6	50.8	28.5	1.0	10.2	39.7	90.5	9.5	100.0
1942	5.1	47.6	52.7	26.0	.2	10.2	36.4	89.1	10.9	100.0
1943	4.9	45.6	50.5	26.7	.2	10.8	37.7	88.2	11.8	100.0
1944	4.8	44.7	49.5	27.7	.7	11.0	39.4	88.9	11.1	100.0
1945 [2]	4.2	42.2	46.4	28.7	1.2	11.6	41.5	87.9	12.1	100.0
1946 [2]	4.6	38.7	43.3	28.9	1.5	14.5	44.9	88.2	11.8	100.0
	Water power counted at prevailing central-station equivalent for year									
1937	5.8	47.8	53.6	31.5	0.7	10.6	42.8	96.4	3.6	100.0
1938	5.9	43.2	49.1	34.4	.7	11.7	46.8	95.9	4.1	100.0
1939	6.1	44.9	51.0	32.9	.9	11.6	45.4	96.4	3.6	100.0
1940	5.5	47.2	52.7	31.7	1.0	11.2	43.9	96.6	3.4	100.0
1941	5.5	48.7	54.2	30.4	1.1	10.9	42.4	96.6	3.4	100.0
1942	5.5	51.4	56.9	28.0	.2	11.1	39.3	96.2	3.8	100.0
1943	5.3	49.5	54.8	28.9	.3	11.8	41.0	95.8	4.2	100.0
1944	5.2	48.3	53.5	29.9	.8	11.9	42.6	96.1	3.9	100.0
1945 [2]	4.5	46.0	50.5	31.2	1.3	12.7	45.2	95.7	4.3	100.0
1946 [2]	5.0	42.1	47.1	31.4	1.6	15.7	48.7	95.8	4.2	100.0

[1] Comparable data for earlier years in Minerals Yearbook, 1937, p. 810 and Minerals Yearbook, 1938, p. 704
[2] Subject to revision. Percentages based upon figures in table 7.

DISTRIBUTION

TABLE 10.—Trends in distribution of bituminous coal and lignite in the United States, 1940–46

[For details and sources of data, see Monthly Report on Distribution of Coal Shipments. Tonnage figures shown in thousands of net tons]

	1940		1941		1942		1943		1944		1945		1946	
	M net tons	Percent	M net tons	Percent	M net tons	Percent	M net tons	Percent	M net tons	Percent	M net tons	Percent	M net tons	Percent
New England receipts:														
Via rail across the Hudson	4,892		6,385		9,894		10,365		9,571		7,872		6,901	
Tidewater loadings:														
By ports:														
At New York and Philadelphia	10,148	28.6	11,974	31.8	20,666	54.0	24,588	62.4	23,118	52.2	21,567	46.1	20,517	41.2
At Baltimore, Hampton Roads, and Charleston	25,291	71.4	25,647	68.2	17,598	46.0	14,840	37.6	21,134	47.8	25,188	53.9	29,342	58.8
Total	35,439	100.0	37,621	100.0	38,264	100.0	39,428	100.0	44,252	100.0	46,755	100.0	49,859	100.0
By fields of origin:														
From Pennsylvania and Northern West Virginia	12,987	36.6	15,217	40.4	19,304	50.4	19,209	48.7	22,531	50.9	24,015	51.4	26,968	54.1
From southern low volatile fields	17,707	50.0	17,560	46.7	16,196	42.3	18,243	46.3	18,177	41.1	16,553	35.4	15,616	31.3
From southern high-volatile fields	4,745	13.4	4,844	12.9	2,764	7.3	1,976	5.0	3,544	8.0	6,187	13.2	7,275	14.6
Total	35,439	100.0	37,621	100.0	38,264	100.0	39,428	100.0	44,252	100.0	46,755	100.0	49,859	100.0
By destinations:														
To New England	12,416	35.1	13,429	35.7	11,727	30.6	12,625	32.0	14,013	31.7	13,118	28.1	12,061	24.2
Foreign	2,989	8.4	2,577	6.8	1,597	4.2	1,505	3.8	2,423	5.5	8,603	18.4	14,776	29.6
Bunkers	1,428	4.0	1,465	3.9	1,270	3.3	1,131	2.9	1,133	2.5	1,360	2.9	1,019	2.1
Inside Capes and other tonnage	18,606	52.5	20,150	53.6	23,670	61.9	24,167	61.3	26,683	60.3	23,674	50.6	22,003	44.1
Total	35,439	100.0	37,621	100.0	38,264	100.0	39,428	100.0	44,252	100.0	46,755	100.0	49,859	100.0
Lake Erie loadings (cargo and fuel):														
By fields of origin:														
From Ohio	2,646	5.5	3,947	7.7	4,171	8.5	4,682	9.9	4,995	9.0	4,322	8.4	4,379	8.9
From Pittsburgh and other Pennsylvania	11,578	24.1	11,612	22.6	9,305	18.8	8,409	17.7	10,568	19.0	9,601	18.7	8,581	17.3
From Moundsville, Fairmont, and Cumberland-Piedmont	2,357	4.9	2,963	5.8	2,778	5.6	2,763	5.8	3,678	6.6	3,645	7.1	3,154	6.4
From Southern West Virginia:														
High-volatile	12,025	25.0	14,277	27.8	14,746	29.8	14,256	30.1	13,902	25.1	12,281	24.0	12,778	25.8
Low-volatile	10,372	21.6	9,010	17.5	9,160	18.5	8,653	18.2	10,797	19.5	10,021	19.5	9,769	19.7
From East Kentucky, Tennessee, and Virginia	9,133	18.9	9,585	18.6	9,295	18.8	8,692	18.3	11,551	20.8	11,438	22.3	10,841	21.9
Total	48,111	100.0	51,394	100.0	49,455	100.0	47,455	100.0	55,491	100.0	51,308	100.0	49,502	100.0

By destinations (cargo only):														
To American points	37,804	81.2	38,823	78.1	36,267	75.9	34,146	74.1	41,773	77.4	39,061	78.3	37,883	78.5
To Canadian points	8,778	18.8	10,886	21.9	11,544	24.1	11,939	25.9	12,210	22.6	10,836	21.7	10,383	21.5
Total	46,582	100.0	49,709	100.0	47,811	100.0	46,085	100.0	53,983	100.0	49,897	100.0	48,266	100.0
Across Lake Michigan car ferry	612		627		740		769		645		522		572	
West-bound rail to Mississippi Valley (revenue all-rail shipments, excluding railroad fuel, Lake coal, and movements to Kentucky points):														
From Ohio fields	9,807	8.0	10,846	7.9	11,719	7.4	12,679	7.6	14,289	8.3	14,991	9.4	15,079	10.2
From Pennsylvania fields	15,195	12.4	16,663	12.1	18,141	11.5	18,189	11.0	19,175	11.2	17,184	10.8	15,801	10.7
From Northern West Virginia and Cumberland-Piedmont	3,467	2.8	4,728	3.4	5,201	3.3	6,268	3.8	7,728	4.5	7,236	4.6	5,349	3.6
From Southern West Virginia:														
High-volatile	16,943	13.8	18,275	13.3	21,500	13.6	22,739	13.6	22,222	13.0	19,205	12.1	19,088	12.9
Low-volatile	19,536	15.9	22,773	16.6	25,005	15.9	24,477	14.7	21,717	12.7	18,919	11.9	18,071	12.2
From East Kentucky, Tennessee, and Virginia	18,340	14.9	18,980	13.8	22,770	14.4	23,010	13.8	20,921	12.2	18,350	11.5	17,841	12.1
Total from Appalachian fields	83,288	67.8	92,265	67.1	104,336	66.1	107,362	64.5	106,052	61.9	95,885	60.3	91,229	61.7
From Illinois	27,618	22.5	30,100	21.9	36,992	23.4	42,326	25.4	46,240	27.0	44,125	27.7	39,297	26.6
From Indiana	10,223	8.3	12,499	9.0	14,031	8.9	13,680	8.2	15,571	9.1	14,730	9.3	12,935	8.7
From West Kentucky	1,758	1.4	2,735	2.0	2,556	1.6	3,195	1.9	3,408	2.0	4,238	2.7	4,488	3.0
Total from Middle West fields	39,599	32.2	45,334	32.9	53,579	33.9	59,201	35.5	65,219	38.1	63,093	39.7	56,720	38.3
Total	122,887	100.0	137,599	100.0	157,915	100.0	166,563	100.0	171,271	100.0	158,978	100.0	147,949	100.0
Total shipments from other groups (all shipments, including, in this case, nonrevenue railroad fuel): [1]														
From Michigan fields	103	(2 3)	120	(2 3)	71	(2 3)	4 57	(2 3)	4 58	(2 3)	4 50	(2 3)	30	(2 3)
From upper Lake commercial docks, all deliveries	12,054	2 2.6	12,473	2 2.4	14,036	2 2.4	15,867	2 2.7	4 14,165	2 2.3	4 14,678	2 2.5	14,110	2 2.7
From Iowa, Missouri, Kansas	6,411	2 1.4	6,731	2 1.3	7,361	2 1.3	4 7,494	2 1.3	4 7,882	2 1.3	4 7,081	2 1.2	5,718	2 1.1
From Arkansas, Oklahoma, Texas	3,394	2.7	3,411	2.7	4,348	2.7	4 4,429	2.8	4 5,012	2.8	4 4,583	2.8	3,667	2.7
From far West fields	19,658	2 4.3	22,009	2 4.3	27,154	2 4.7	4 30,692	2 5.2	4 31,402	2 5.1	4 30,358	2 5.3	24,473	2 4.6
From Alabama field	14,288	2 3.1	14,310	2 3.1	17,525	2 3.0	4 15,705	2 2.7	4 17,153	2 2.8	4 16,399	2 2.8	14,890	2 2.8

[1] Excluding commercial sales by truck and wagon, except from upper Lake docks.
[2] Percent of total national production from all mines, all destinations.
[3] Less than 0.1 percent.
[4] Revised figure.

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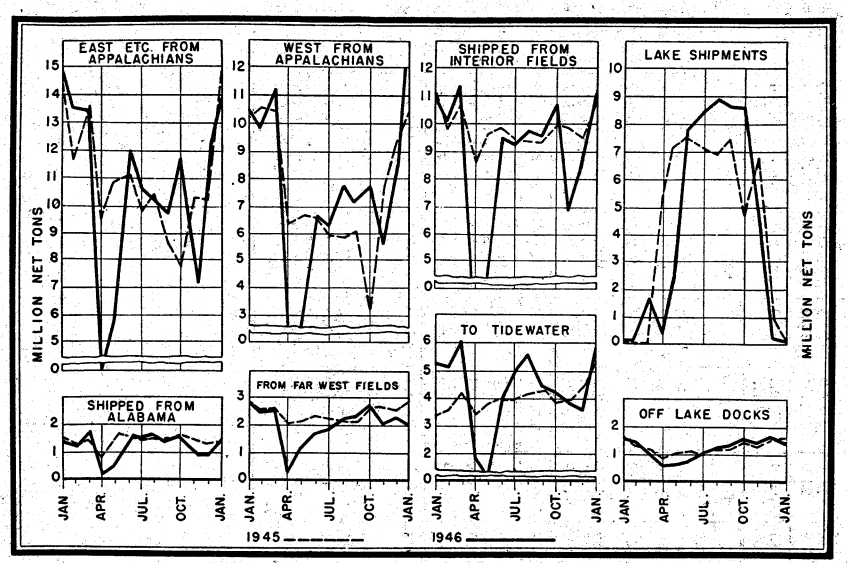

FIGURE 9.—Monthly movement of bituminous coal and lignite in the United States in the major channels of distribution, 1945–46.

STOCKS HELD BY CONSUMERS

TABLE 11.—Stocks of bituminous coal and lignite in hands of commercial consumers and in retail dealers' yards in the United States, 1945–46

Date	Total stocks (net tons)	Days' supply at current rate of consumption on date of stock taking								
		By-product coke plants	Steel plants	Other industrials	Coal-gas plants	Electric utilities	Retail yards	Railroads	Cement mills	Total
1945										
January 1	57,204,000	24	21	38	55	72	11	34	47	32
February 1	49,464,000	22	19	31	46	61	6	29	52	26
March 1	45,773,000	22	20	29	40	58	6	27	51	24
April 1	45,495,000	21	24	33	39	63	9	27	52	27
May 1	43,793,000	18	24	35	39	63	15	27	44	30
June 1	44,020,000	17	25	36	44	65	14	27	45	30
July 1	47,715,000	21	28	41	50	69	18	29	46	33
August 1	49,906,000	19	27	51	(1)	73	21	31	46	37
September 1	51,141,000	19	30	53	(1)	76	20	33	43	38
October 1	53,350,000	19	33	56	(1)	88	20	35	45	41
November 1	48,015,000	20	21	44	(1)	84	15	32	41	36
December 1	48,919,000	20	22	39	(1)	83	13	31	42	33
December 31	45,665,000	20	20	32	(1)	78	8	25	43	27
1946										
January 1	45,665,000	20	20	32	(1)	78	8	25	43	27
February 1	46,528,000	33	35	32	(1)	78	5	27	39	28
March 1	51,158,000	48	29	37	(1)	84	6	32	39	31
April 1	58,531,000	36	38	48	(1)	95	12	39	42	42
May 1	38,741,000	22	24	44	(1)	70	18	27	24	36
June 1	31,643,000	22	26	41	(1)	67	15	24	21	34
July 1	37,777,000	17	32	43	(1)	68	17	27	25	33
August 1	43,611,000	16	30	54	(1)	68	15	27	29	34
September 1	47,990,000	21	34	57	(1)	68	14	28	35	36
October 1	52,367,000	23	35	58	(1)	70	12	30	41	37
November 1	54,924,000	26	32	55	(1)	72	11	30	47	36
December 1	52,429,000	27	33	52	(1)	68	9	26	46	35
December 31	47,157,000	24	28	45	(1)	60	10	23	41	32

[1] Included in "Other industrials."

FINAL BITUMINOUS-COAL AND LIGNITE STATISTICS FOR 1945

Tables 12 to 55 give the final detailed statistics of bituminous-coal- and lignite-mine operations in 1945. The subjects covered include production, number and size of mines, employment, value, mechanization, exports, and world production.

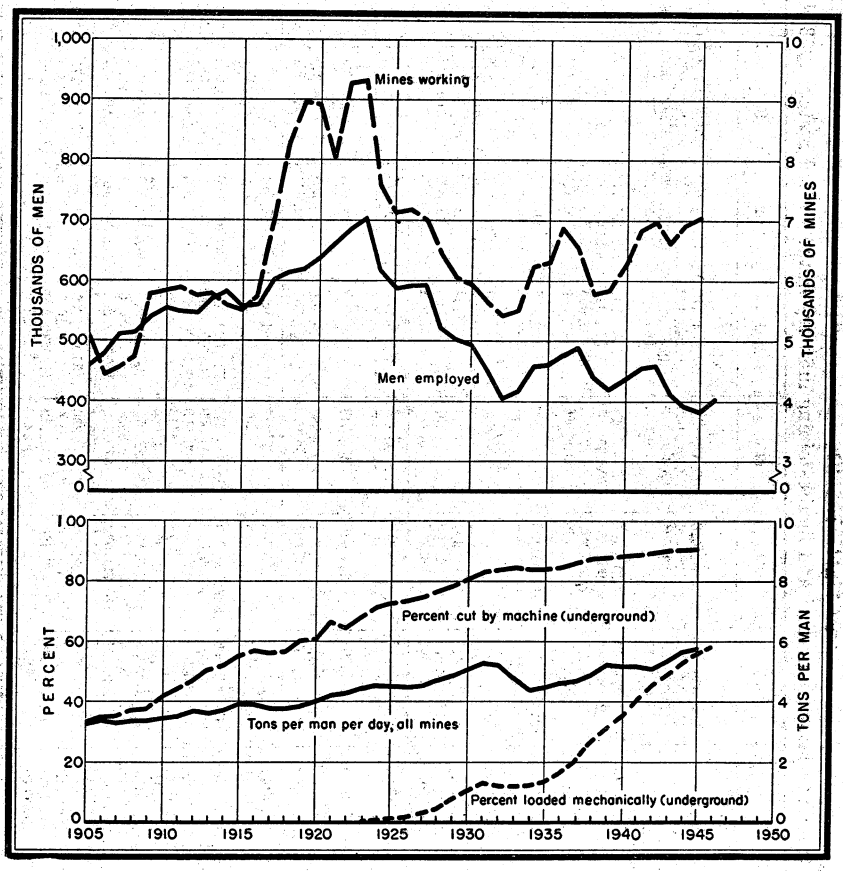

FIGURE 10.—Trends of employment, mechanization, and output per man at bituminous-coal and lignite mines in the United States, 1905–46.

SALIENT TRENDS

TABLE 12.—Salient trends in bituminous-coal and lignite-mining industry in the United States, 1938–45

	1938	1939	1940	1941	1942	1943	1944	1945
Production:								
Loaded at mine for shipment by rail—net tons	295,336,027	331,189,620	380,387,674	425,184,319	482,814,042	495,863,581	527,135,489	490,471,988
Loaded at mine for shipment by water—do	16,902,969	22,229,364	29,493,058	30,240,489	34,018,025	30,188,093	31,518,334	27,547,679
Shipped by truck or wagon—do	25,592,058	29,533,824	35,540,476	40,055,638	45,154,432	42,432,667	40,123,023	41,477,428
Taken by locomotive tenders at tipple—do	606,857	826,556	939,058	1,099,582	920,213	779,154	807,679	694,555
Shipped by conveyor or tram to point of consumption—net tons	4,221,671	4,317,465	5,887,994	6,067,697	7,121,116	7,476,717	7,206,392	6,416,327
Used by mine employees—do	2,032,289	1,901,408	2,035,201	1,872,026	2,180,077	2,549,775	2,545,343	2,660,039
Used at mines for power and heat—do	2,493,017	2,565,276	2,442,989	2,488,950	2,708,312	2,701,828	2,713,073	2,442,398
Made into beehive coke at mines—do	1,359,876	2,089,475	4,045,050	7,140,544	7,776,720	8,185,254	7,526,907	5,906,913
Total production—do	348,544,764	[1] 394,855,325	460,771,500	514,149,245	582,692,937	590,177,069	619,576,240	577,617,327
Number of active mines of commercial size:								
Class 1 (200,000 tons or more)—number	526	577	636	730	811	855	828	753
Class 2 (100,000 to 200,000 tons)—do	402	404	432	437	484	464	559	591
Class 3 (50,000 to 100,000 tons)—do	415	387	371	402	445	481	540	629
Class 4 (10,000 to 50,000 tons)—do	1,042	1,065	1,157	1,305	1,492	1,544	1,776	1,920
Class 5 (1,000 to 10,000 tons)—do	3,392	3,387	3,728	3,948	3,740	3,276	3,225	3,140
Total number over 1,000 tons—do	5,777	5,820	6,324	6,822	6,972	6,620	6,928	7,033
Average number of men employed at mines active:								
Underground—men	370,004	353,476	365,013	376,765	374,654	326,763	301,461	290,091
Surface:								
In strip pits—do	7,877	8,791	8,983	10,861	12,893	16,643	21,035	23,261
All others—do	63,452	59,521	65,079	69,355	74,444	72,601	70,851	69,838
Total—do	441,333	421,788	439,075	456,981	461,991	416,007	393,347	383,100
Average number of days mines operated—days	162	178	202	216	246	264	278	261
Capacity of active mines with existing labor force:								
Per year of 308 days—net tons	663,000,000	683,000,000	703,000,000	733,000,000	730,000,000	689,000,000	686,000,000	682,000,000
Per year of 280 days—do	602,000,000	621,000,000	639,000,000	666,000,000	663,000,000	626,000,000	624,000,000	620,000,000
Per year of 261 days—do	562,000,000	579,000,000	595,000,000	621,000,000	618,000,000	583,000,000	582,000,000	578,000,000
Output per man per day—do	4.89	5.25	5.19	5.20	5.12	5.38	5.67	5.78
Output per man per year—do	790	936	1,049	1,125	1,261	1,419	1,575	1,508
Underground output cut by machine—do	278,315,365	313,969,394	369,227,277	408,510,296	462,344,719	461,051,743	469,458,349	424,726,432
Percent of underground output cut by machine—percent	87.5	87.9	88.4	89.0	89.7	90.3	90.5	90.8
Underground output mechanically loaded—net tons	85,092,836	110,711,970	147,870,252	186,667,250	232,902,920	249,805,214	274,189,132	262,512,729
Percent of underground output mechanically loaded—percent	26.7	31.0	35.4	40.7	45.2	48.9	52.9	56.1
Quantity mined by stripping—net tons	30,406,855	37,722,583	43,167,336	55,071,609	67,202,663	79,685,175	100,898,376	109,986,865
Percent mined by stripping—percent	8.7	9.6	9.4	10.7	11.5	13.5	16.3	19.0
Quantity cleaned by wet or pneumatic process [2]—net tons	63,454,588	79,429,426	102,269,753	117,539,522	142,187,346	145,575,849	158,727,129	147,885,936
Percent cleaned by wet or pneumatic process [2]—percent	18.2	20.1	22.2	22.9	24.4	24.7	25.6	25.6

[1] Includes 202,337 tons of coal reported as net changes in stocks at mines, Jan. 1, 1939 to Jan. 1, 1940.
[2] Includes central washeries operated by consumers.

TABLE 13.—Coal produced in the United States, by States, 1935–45, with production of maximum year and cumulative production from earliest record to end of 1945, in thousands of net tons

State	Maximum production		Production by years											Total production from earliest record to end of 1945
	Year	Quantity	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	
Alabama	1926	21,001	8,505	12,229	12,440	11,062	12,047	15,324	15,464	19,301	17,160	18,752	18,236	755,312
Arkansas	1907	2,670	1,133	1,623	1,511	1,197	1,152	1,454	1,574	1,985	1,718	1,972	1,854	85,250
Colorado	1917	12,483	5,911	6,812	7,187	5,663	5,923	6,589	6,949	8,086	8,324	8,168	7,621	448,582
Georgia	1903	416	(1)	(1)	(1)	(1)	(1)	(1)	(1)	31	14	24	43	(1)
Illinois	1918	89,291	44,525	50,927	51,602	41,912	46,783	50,610	54,703	65,071	72,631	76,792	73,011	2,887,404
Indiana	1918	30,679	15,754	17,822	17,765	14,759	16,943	18,869	22,484	25,388	25,065	27,962	25,183	897,743
Iowa	1917	8,966	3,650	3,961	3,637	3,103	2,948	3,231	2,939	2,948	2,771	2,141	2,046	330,866
Kansas	1918	7,562	2,686	2,944	2,893	2,654	2,675	3,579	4,008	4,230	3,437	3,369	3,228	256,244
Kentucky	1944	71,356	40,761	47,522	47,086	38,545	42,557	49,141	53,710	62,231	63,211	71,356	69,593	1,660,313
Maryland	1907	5,533	1,678	1,704	1,549	1,281	1,443	1,503	1,701	2,001	1,933	1,870	1,763	253,442
Michigan	1907	2,036	628	626	562	494	457	410	311	231	169	140	126	46,254
Missouri	1917	5,671	3,646	3,985	4,091	3,436	3,273	3,097	3,145	3,520	4,310	4,779	3,983	241,829
Montana (bituminous and lignite)	1944	4,844	2,759	2,988	2,965	2,732	2,804	2,867	3,254	3,829	4,833	4,844	4,467	144,698
New Mexico	1918	4,023	1,389	1,597	1,715	1,239	1,230	1,111	1,251	1,669	1,851	1,744	1,484	116,349
North Carolina	1922	79	(1)											(1)
North Dakota (lignite)	1942	2,537	1,956	2,215	2,251	2,050	2,072	2,218	2,309	2,537	2,500	2,366	2,522	56,397
Ohio	1920	45,878	21,153	24,110	25,178	18,591	20,289	22,772	29,319	32,764	32,255	33,877	32,737	1,558,151
Oklahoma	1920	4,849	1,229	1,540	1,600	1,245	1,188	1,646	1,771	2,387	2,838	3,209	2,909	146,223
Pennsylvania (bituminous)	1918	178,551	91,405	109,887	111,002	77,705	92,584	116,603	130,240	144,073	141,050	146,052	132,965	6,869,458
Tennessee	1942	8,158	4,138	5,108	5,213	4,472	5,185	6,008	7,045	8,158	7,179	7,266	6,271	301,781
Texas (bituminous and lignite)	1913	2,429	758	843	910	879	826	621	353	304	153	[2] 109	[2] 80	60,688
Utah	1944	7,119	2,947	3,247	3,810	2,947	3,285	3,576	4,077	5,517	6,666	7,119	6,679	171,470
Virginia	1943	20,280	9,667	11,662	13,795	12,283	13,531	15,348	18,441	20,136	20,280	19,514	17,235	485,842
Washington	1918	4,082	1,559	1,812	2,002	1,567	1,690	1,650	1,841	1,953	1,528	1,524	1,357	138,221
West Virginia	1944	164,704	99,179	117,926	118,646	93,288	108,362	126,438	140,250	155,882	158,804	164,704	152,035	4,350,094
Wyoming	1945	9,847	5,177	5,781	5,918	5,204	5,373	5,808	6,646	8,133	9,155	9,540	9,847	335,362
Other States			180	217	203	237	235	299	364	328	342	383	342	64,100
Total bituminous and lignite	1944	619,576	372,373	439,088	445,531	348,545	394,855	460,772	514,149	582,693	590,177	619,576	577,617	22,662,073
Pennsylvania anthracite	1917	99,612	52,159	54,580	51,856	46,099	51,487	51,485	56,368	60,328	60,644	63,701	54,934	4,681,404
Grand total			424,532	493,668	497,387	394,644	446,342	512,257	570,517	643,021	650,821	683,277	632,551	27,343,477

[1] Included under "Other States."
[2] Lignite only.

TABLE 14.—Growth of the bituminous-coal and lignite-mining industry in the United States, 1890–1945

Year	Production (net tons)	Value		Men employed	Number of mines	Calculated capacity (millions of net tons)—		
		Total [1]	Average per ton [1]			At 308 days	At 280 days	At 261 days
1890	111,302,322	$110,420,801	$0.99	192,204	[2]	152	137	129
1891	117,901,238	117,188,400	.99	205,803	[2]	163	148	138
1892	126,856,567	125,124,381	.99	212,893	[2]	178	162	151
1893	128,385,231	122,751,618	.96	230,365	[2]	194	174	164
1894	118,820,405	107,653,501	.91	244,603	[2]	214	196	181
1895	135,118,193	115,779,771	.86	239,962	2,555	215	196	182
1896	137,640,276	114,891,515	.83	244,171	2,599	221	202	187
1897	147,617,519	119,595,224	.81	247,817	2,454	232	213	197
1898	166,593,623	132,608,713	.80	255,717	2,862	243	221	206
1899	193,323,187	167,952,104	.87	271,027	3,245	254	230	216
1900	212,316,112	220,930,313	1.04	304,375	[2]	279	255	237
1901	225,828,149	236,422,049	1.05	340,235	[2]	309	281	262
1902	260,216,844	290,858,483	1.12	370,056	[2]	348	316	295
1903	282,749,348	351,687,933	1.24	415,777	[2]	387	350	328
1904	278,659,689	305,397,001	1.10	437,832	4,650	425	386	360
1905	315,062,785	334,658,294	1.06	460,629	5,060	460	417	390
1906	342,874,867	381,162,115	1.11	478,425	4,430	496	451	420
1907	394,759,112	451,214,842	1.14	513,258	4,550	520	473	440
1908	332,573,944	374,135,268	1.12	516,264	4,730	531	482	450
1909	379,744,257	405,486,777	1.07	543,152	5,775	560	510	474
1910	417,111,142	469,281,719	1.12	555,533	5,818	592	538	502
1911	405,907,059	451,375,819	1.11	549,775	5,887	593	538	502
1912	450,104,982	517,983,445	1.15	548,632	5,747	622	566	527
1913	478,435,297	565,234,952	1.18	571,882	5,776	635	577	538
1914	422,703,970	493,309,244	1.17	583,506	5,592	668	608	566
1915	442,624,426	502,037,688	1.13	557,456	5,502	672	610	569
1916	502,519,682	665,116,077	1.32	561,102	5,726	673	613	570
1917	551,790,563	1,249,272,837	2.26	603,143	6,939	699	636	593
1918	579,385,820	1,491,809,940	2.58	615,305	8,319	717	650	607
1919	465,860,058	1,160,616,013	2.49	621,998	8,994	736	669	624
1920	568,666,683	2,129,933,000	3.75	639,547	8,921	796	725	675
1921	415,921,950	1,199,983,600	2.89	663,754	8,038	860	781	729
1922	422,268,099	1,274,820,000	3.02	687,958	9,299	916	832	776
1923	564,564,662	1,514,621,000	2.68	704,793	9,331	970	885	823
1924	483,686,538	1,062,626,000	2.20	619,604	7,586	871	792	738
1925	520,052,741	1,060,402,000	2.04	588,493	7,144	822	748	696
1926	573,366,985	1,183,412,000	2.06	593,647	7,177	821	747	696
1927	517,763,352	1,029,657,000	1.99	593,918	7,011	835	759	708
1928	500,744,970	933,774,000	1.86	522,150	6,450	760	691	644
1929	534,988,593	952,781,000	1.78	502,993	6,057	752	679	638
1930	467,526,299	795,483,000	1.70	493,202	5,891	770	700	653
1931	382,089,396	588,895,000	1.54	450,213	5,642	736	669	623
1932	309,709,872	406,677,000	1.31	406,380	5,427	653	594	554
1933	333,630,533	445,788,000	1.34	418,703	5,555	615	559	521
1934	359,368,022	628,383,000	1.75	458,011	6,258	622	565	527
1935	372,373,122	658,063,000	1.77	462,403	6,315	640	582	543
1936	439,087,903	770,955,000	1.76	477,204	6,875	680	618	576
1937	445,531,449	864,042,000	1.94	491,864	6,548	710	646	601
1938	348,544,764	678,653,000	1.95	441,333	5,777	663	602	562
1939	394,855,325	728,348,366	1.84	421,788	5,820	683	621	579
1940	460,771,500	879,327,227	1.91	439,075	6,324	703	639	595
1941	514,149,245	1,125,362,836	2.19	456,981	6,822	733	666	621
1942	582,692,937	1,373,990,608	2.36	461,991	6,972	730	663	618
1943	590,177,069	1,584,644,477	2.69	416,007	6,620	689	626	583
1944	619,576,240	1,810,900,542	2.92	393,347	6,928	686	624	582
1945	577,617,327	1,768,204,320	3.06	383,100	7,033	682	620	578

[1] Figures on value and value per ton for 1890 to 1936, inclusive, and 1939 exclude selling expense. Figures for other years include selling expense.
[2] Data not available.

TABLE 14.—Growth of the bituminous-coal and lignite-mining industry in the United States, 1890–1945—Continued

Year	Average number of days worked	Average number of days lost on account of strikes—		Net tons per man—		Percent of underground production—		Percent of total production—	
		Per man employed	Per man on strike	Per day	Per year	Cut by machines[3]	Mechanically loaded	Mechanically cleaned[4]	Mined by stripping
1890	226	[2]	[2]	2.56	579	[2]	[2]	[2]	[2]
1891	223	[2]	[2]	2.57	573	5.3	[2]	[2]	[2]
1892	219	[2]	[2]	2.72	596	[2]	[2]	[2]	[2]
1893	204	[2]	[2]	2.73	557	[2]	[2]	[2]	[2]
1894	171	[2]	[2]	2.84	486	[2]	[2]	[2]	[2]
1895	194	[2]	[2]	2.90	563	[2]	[2]	[2]	[2]
1896	192	[2]	[2]	2.94	564	11.9	[2]	[2]	[2]
1897	196	[2]	[2]	3.04	596	15.3	[2]	[2]	[2]
1898	211	[2]	[2]	3.09	651	19.5	[2]	[2]	[2]
1899	234	8	46	3.05	713	22.7	[2]	[2]	[2]
1900	234	5	43	2.98	697	24.9	[2]	[2]	[2]
1901	225	2	35	2.94	664	25.6	[2]	[2]	[2]
1902	230	7	44	3.06	703	26.8	[2]	[2]	[2]
1903	225	3	28	3.02	680	27.6	[2]	[2]	[2]
1904	202	8	44	3.15	637	28.2	[2]	[2]	[2]
1905	211	2	23	3.24	684	32.8	[2]	[2]	[2]
1906	213	28	63	3.36	717	34.7	[2]	2.7	[2]
1907	234	1	14	3.29	769	35.1	[2]	2.9	[2]
1908	193	11	38	3.34	644	37.0	[2]	3.6	[2]
1909	209	1	29	3.34	699	37.5	[2]	3.8	[2]
1910	217	35	89	3.46	751	41.7	[2]	3.8	[2]
1911	211	2	27	3.50	738	43.9	[2]	[2]	[2]
1912	223	10	35	3.68	820	46.8	[2]	3.9	[2]
1913	232	4	36	3.61	837	50.7	[2]	4.6	[2]
1914	195	19	80	3.71	724	51.8	[2]	4.8	0.3
1915	203	4	61	3.91	794	55.3	[2]	4.7	.6
1916	230	4	26	3.90	896	56.9	[2]	4.6	.8
1917	243	4	17	3.77	915	56.1	[2]	4.6	1.0
1918	249	1	7	3.78	942	56.7	[2]	3.8	1.4
1919	195	25	37	3.84	749	60.0	[2]	3.6	1.2
1920	220	6	22	4.00	881	60.7	[2]	3.3	1.5
1921	149	3	23	4.20	627	66.4	[2]	3.4	1.2
1922	142	78	117	4.28	609	64.8	[2]	[2]	2.4
1923	179	2	20	4.47	801	68.3	0.3	3.8	2.1
1924	171	7	73	4.56	781	71.5	.7	[2]	2.8
1925	195	2	30	4.52	884	72.9	1.2	[2]	3.2
1926	215	1	24	4.50	966	73.8	1.8	[2]	3.0
1927	191	45	153	4.55	872	74.9	3.3	5.3	3.6
1928	203	8	83	4.73	959	76.9	4.5	5.7	4.0
1929	219	[5]	11	4.85	1,064	78.4	7.4	6.9	3.8
1930	187	2	43	5.06	948	81.0	10.5	8.3	4.3
1931	160	3	35	5.30	849	83.2	13.1	9.5	5.0
1932	146	19	120	5.22	762	84.1	12.3	9.8	6.3
1933	167	9	30	4.78	797	84.7	12.0	10.4	5.5
1934	178	3	15	4.40	785	84.1	12.2	11.1	5.8
1935	179	[2]	[2]	4.50	805	84.2	13.5	12.2	6.4
1936	199	2	21	4.62	920	84.8	16.3	13.9	6.4
1937	193	[2]	[2]	4.69	906	[2]	20.2	14.6	7.1
1938	162	1	13	4.89	790	87.5	26.7	18.2	8.7
1939	178	25	36	5.25	936	87.9	31.0	20.1	9.6
1940	202	1	8	5.19	1,049	88.4	35.4	22.2	9.4
1941	216	20	27	5.20	1,125	89.0	40.7	22.9	10.7
1942	246	1	7	5.12	1,261	89.7	45.2	24.4	11.5
1943	264	[2]	[2]	5.38	1,419	90.3	48.9	24.7	13.5
1944	278	[2]	[2]	5.67	1,575	90.5	52.9	25.6	16.3
1945	261	[2]	[2]	5.78	1,508	90.8	56.1	25.6	19.0

[2] Data not available.
[3] Percentages for 1890 to 1913, inclusive, are of total production, as separation of strip-mine and underground production is not available for those years.
[4] For 1906 to 1926, inclusive, percentages are exclusive of coal cleaned at central washeries operated by consumers; after 1926, when data became available on the tonnage cleaned by consumer-operated plants, percentages include total tons cleaned at mines and at consumer-operated washeries.
[5] One-half day or less.

TABLE 15.—Growth of strip mining at bituminous-coal and lignite mines in the United States, 1914–45

Year	Production (thousands of net tons)			Percent of total production mined by stripping	Average tons per man per day			Average value per ton, f. o. b. mine			Number of strip mines	Number of power shovels and draglines
	Strip mines	Underground mines	Total all mines		Strip mines [1]	Underground mines [2]	Total all mines	Strip mines [1]	Underground mines [2]	Total all mines		
1914	1,281	421,423	422,704	0.3	5.06	3.71	3.71	(3)	(3)	$1.17	[4] 35	48
1915	2,832	439,792	442,624	.6	5.81	3.90	3.91	$1.18	$1.13	1.13	[4] 60	87
1916	3,933	498,587	502,520	.8	6.67	3.88	3.90	1.51	1.32	1.32	[4] 79	111
1917	5,790	546,001	551,791	1.0	6.52	3.75	3.77	2.34	2.26	2.26	[4] 126	182
1918	8,288	571,098	579,386	1.4	6.81	3.76	3.78	2.54	2.58	2.58	[4] 165	276
1919	5,635	460,225	465,860	1.2	6.21	3.82	3.84	2.33	2.49	2.49	[4] 168	287
1920	8,860	559,807	568,667	1.5	7.20	3.97	4.00	4.12	3.74	3.75	[4] 174	312
1921	5,057	410,865	415,922	1.2	8.28	4.18	4.20	2.87	2.89	2.89	[4] 155	279
1922	10,209	412,059	422,268	2.4	8.09	4.24	4.28	3.07	3.02	3.02	272	379
1923	11,940	552,625	564,565	2.1	9.32	4.43	4.47	2.31	2.69	2.68	263	442
1924	13,607	470,080	483,687	2.8	9.91	4.50	4.56	2.00	2.20	2.20	234	420
1925	16,871	503,182	520,053	3.2	11.18	4.45	4.52	1.84	2.05	2.04	227	389
1926	16,923	556,444	573,367	3.0	11.13	4.42	4.50	1.89	2.07	2.06	237	410
1927	18,378	499,385	517,763	3.6	11.06	4.47	4.55	1.90	1.99	1.99	255	455
1928	19,789	480,956	500,745	4.0	13.02	4.61	4.73	1.69	1.87	1.86	250	415
1929	20,268	514,721	534,989	3.8	14.08	4.73	4.85	1.57	1.79	1.78	200	411
1930	19,842	447,684	467,526	4.3	16.21	4.93	5.06	1.54	1.71	1.70	218	341
1931	18,932	363,157	382,089	5.0	17.68	5.12	5.30	1.51	1.54	1.54	235	314
1932	19,641	290,069	309,710	6.3	16.95	4.99	5.22	1.32	1.31	1.31	255	332
1933	18,270	315,360	333,630	5.5	13.59	4.60	4.78	1.33	1.34	1.34	289	389
1934	20,790	338,578	359,368	5.8	13.28	4.23	4.40	1.49	1.76	1.75	344	458
1935	23,647	348,726	372,373	6.4	12.01	4.32	4.50	1.47	1.79	1.77	368	507
1936	28,126	410,962	439,088	6.4	13.91	4.42	4.62	1.49	1.77	1.76	381	562
1937	31,751	413,780	445,531	7.1	(3)	(3)	4.69	(3)	(3)	1.94	449	(3)
1938	30,407	318,138	348,545	8.7	15.00	4.60	4.89	(3)	(3)	1.95	465	737
1939	37,722	357,133	394,855	9.6	14.68	4.92	5.25	1.49	1.88	1.84	537	914
1940	43,167	417,604	460,771	9.4	15.63	4.86	5.19	1.56	1.94	1.91	638	1,071
1941	55,071	459,078	514,149	10.7	15.59	4.83	5.20	1.79	2.23	2.19	769	1,321
1942	67,203	515,490	582,693	11.5	15.52	4.74	5.12	1.90	2.41	2.36	834	1,438
1943	79,685	510,492	590,177	13.5	15.15	4.89	5.38	2.28	2.75	2.69	1,004	1,839
1944	100,898	518,678	619,576	16.3	15.89	5.04	5.67	2.48	3.01	2.92	1,240	2,312
1945	109,987	467,630	577,617	19.0	15.46	5.04	5.78	2.65	3.16	3.06	1,370	2,439

[1] Includes power strip pits proper and excludes horse stripping operations and mines combining stripping and underground in same operation for 1914–42, inclusive. 1943, 1944, and 1945 include data on all strip mines.
[2] Computed by deducting "Strip mines" data from "Total all mines."
[3] Data not available.
[4] Exclusive of horse stripping operations.

TABLE 16.—Growth of mechanical loading at underground bituminous-coal and lignite mines in the United States, 1923–45

[Production in thousands of net tons]

Year	Underground production mechanically loaded								Total underground production	Percent of underground production mechanically loaded	Number of mechanical loading units in actual use					
	Loaded by machines				Handled by conveyors			Total mechanically loaded			Mobile loading machines	Scrapers	Conveyors equipped with duckbills or other self-loading heads	Pit-car loaders	Hand loaded conveyors	Total all types
	Mobile loading machines	Scrapers	Conveyors equipped with duckbills or other self-loading heads	Total	Pit-car loaders	Hand loaded conveyors	Total									
1923	(1)	(1)	(1)	(1)	(1)	(1)	(1)	[2] 1,880	552,625	[2] 0.3	(1)	(1)	(1)	(1)	(1)	(1)
1924	(1)	(1)	(1)	(1)	(1)	(1)	(1)	[2] 3,496	470,080	[2] .7	(1)	(1)	(1)	(1)	(1)	(1)
1925	(1)	(1)	(1)	(1)	(1)	(1)	(1)	[2] 6,243	503,182	[2] 1.2	(1)	(1)	(1)	(1)	(1)	(1)
1926	7,786	1,554	682	10,022	523	(1)	(1)	[2] 10,545	556,444	[2] 1.8	295	133	27	(1)	(1)	(1)
1927	(1)	(1)	(1)	(1)	(1)	(1)	(1)	16,500	499,385	3.3	(1)	(1)	(1)	(1)	(1)	(1)
1928	11,811	1,548	1,200	14,559	4,117	2,883	7,000	21,559	480,956	4.5	397	130	82	1,040	(1)	(1)
1929	16,432	1,550	1,309	19,291	14,979	3,592	18,571	37,862	514,721	7.4	488	126	99	2,521	(1)	(1)
1930	20,073	1,637	1,628	23,338	19,116	4,528	23,644	46,982	447,684	10.5	545	150	140	2,876	(1)	(1)
1931	19,407	1,471	1,811	22,689	19,172	5,701	24,873	47,562	363,157	13.1	583	146	165	3,428	(1)	(1)
1932	14,825	1,132	1,630	17,587	12,590	5,640	18,230	35,817	290,069	12.3	548	128	159	3,112	(1)	(1)
1933	17,865	991	1,656	20,512	11,413	5,896	17,309	37,821	315,360	12.0	523	93	132	2,453	525	3,726
1934	20,750	1,004	2,082	23,836	11,089	6,508	17,597	41,433	338,578	12.2	534	119	157	2,288	574	3,672
1935	24,675	1,118	2,595	28,388	11,098	7,691	18,789	47,177	348,726	13.5	657	78	179	2,098	670	3,682
1936	40,970	1,273	3,240	45,483	10,538	10,956	21,494	66,977	410,962	16.3	980	106	234	1,851	936	4,107
1937	(1)	(1)	(1)	(1)	(1)	(1)	(1)	83,500	413,780	20.2	(1)	(1)	(1)	(1)	(1)	(1)
1938	57,824	1,031	4,248	63,103	5,653	16,337	21,990	85,093	318,138	26.7	1,405	117	346	1,392	1,526	4,786
1939	76,442	1,007	6,759	84,208	5,038	21,466	26,504	110,712	357,133	31.0	1,573	131	559	873	1,834	4,970
1940	100,962	1,255	10,362	112,579	3,979	31,312	35,291	147,870	417,604	35.4	1,720	116	656	697	2,263	5,452
1941	126,478	1,290	14,918	142,686	3,447	40,534	43,981	186,667	459,078	40.7	1,985	109	788	607	2,807	6,296
1942	160,301	1,405	20,683	182,389	3,252	47,262	50,514	232,903	515,490	45.2	2,301	93	1,062	481	3,041	6,978
1943	179,008	1,349	22,917	203,274	2,669	43,862	46,531	249,805	510,492	48.9	2,525	83	1,226	321	3,191	7,346
1944	202,875	1,341	23,164	227,380	1,835	44,974	46,809	274,189	518,678	52.9	2,737	87	1,331	241	3,236	7,632
1945	198,668	1,252	21,506	221,426	986	40,100	41,086	262,512	467,630	56.1	2,950	87	1,383	142	3,385	7,947

[1] Data not available.
[2] Exclusive of tonnage "Handled by conveyors."

SUMMARY BY STATES AND DISTRICTS

TABLE 17.—Number of mines, production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by States, in 1945

[Exclusive of mines producing less than 1,000 tons]

State	Number of active mines	Disposition of coal produced (net tons)								Average value per ton [3]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
		Loaded at mine directly into railroad cars or river barges	Hauled by truck to railroad siding for shipment by rail and to waterway for shipment by water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Taken by locomotive tenders at tipple	Shipped by conveyor or tram to point of consumption	Used by mine employees	Used at mines for power and heat and made into beehive coke at mines [2]	Total quantity		Underground	Surface					
												In strip pits	All others	Total			
Alabama	377	15,215,244	1,144,614	1,340,593	61,391	295,802	88,820	90,075	18,236,539	$4.19	16,650	918	3,413	20,981	270	5,662,666	3.22
Alaska	5	258,079	6,053	23,274	1,425			8,813	297,644	6.28	267		68	335	302	101,035	2.95
Arizona	1			3,853					3,853	3.50	7		1	8	268	2,144	1.80
Arkansas	67	1,310,301	471,724	65,632			3,426	2,843	1,853,926	5.05	1,560	417	399	2,376	217	514,820	3.60
Colorado	166	5,392,780	424,375	1,438,686	12,665	63,436	39,463	[2] 249,607	7,621,012	3.69	5,213	38	1,179	6,430	261	1,681,071	4.53
Georgia	3	38,701		3,000			445	422	42,568	3.85	64	10	15	89	256	22,798	1.87
Illinois	313	63,773,758	[1] 1,529,018	6,303,908	16,660	224,109	333,477	830,262	73,011,192	2.34	22,131	1,743	7,374	31,248	258	8,061,662	9.06
Indiana	134	21,674,200	722,767	2,147,033	7,541	466,833	37,911	126,326	25,182,611	2.32	5,296	1,830	2,646	9,772	241	2,351,205	10.71
Iowa	117	667,646	392,347	960,705			18,011	6,891	2,045,600	3.51	1,791	202	378	2,371	216	512,882	3.99
Kansas	51	2,955,684	44,836	166,134	2,000	44,173	8,024	7,708	3,228,559	2.57	490	624	388	1,502	249	373,904	8.63
Kentucky	1,441	56,823,225	5,640,164	6,438,519	8,345	108,063	355,700	[3] 218,920	69,592,936	3.00	42,773	995	8,790	52,558	254	13,341,224	5.22
Maryland	94	1,173,563	283,736	294,729	1,131		6,340	3,204	1,762,703	3.61	1,329	141	265	1,735	257	446,039	3.95
Michigan	3	49,803		65,208			1,642	9,051	125,704	5.47	142		31	173	268	46,341	2.71
Missouri	86	2,947,467	72,965	949,115			8,974	4,203	3,982,724	2.59	857	639	475	1,971	228	448,648	8.88
Montana:																	
Bituminous	26	4,269,212	25,347	113,653	123		10,314	6,542	4,425,191	1.88	732	86	320	1,138	260	296,125	14.94
Lignite	7			[4] 41,597			(4)		41,597	2.38	31	2	7	40	196	7,828	5.31
Total Montana	33	4,269,212	25,347	155,250	123		10,314	6,542	4,466,788	1.89	763	88	327	1,178	258	303,953	14.70
New Mexico	26	1,327,919	14,376	88,814			8,427	44,150	1,483,686	3.80	1,005	8	298	1,311	270	354,499	4.19
North Dakota (lignite)	53	2,023,257		430,445		[4] 47,486	(4)	21,131	2,522,319	1.56	227	282	248	757	226	171,251	14.73
Ohio	535	23,799,192	[3] 3,049,682	5,757,247		34,173	67,149	29,992	32,737,435	2.79	12,175	2,777	3,716	18,668	241	4,503,840	7.27
Oklahoma	76	2,424,425	297,309	170,849			1,487	14,906	2,908,976	3.61	1,380	386	464	2,230	224	500,036	5.82
Oregon	1		7,718	8,752			30		16,500	3.99	24		13	37	192	7,104	2.32

Pennsylvania	1,957	92,380,040	[1]20,342,100	10,733,300	186,686	3,278,635	570,073	[2] 5,474,509	132,965,343	3.29	72,967	7,947	15,022	95,936	257	24,654,211	5.39
South Dakota (lignite)	4		5,360	[4] 19,085			(4)		24,445	2.17	4	11		15	259	3,881	6.30
Tennessee	140	5,093,069	[1] 750,341	311,568	38,901		60,710	16,119	6,270,708	3.43	5,356	110	1,006	6,472	240	1,556,265	4.03
Texas (lignite)	1	79,051			898				79,949	.85		19	7	26	158	4,096	19.52
Utah	52	6,260,025	124,492	225,039	895		42,829	[3] 25,783	6,679,063	3.41	2,771		945	3,716	291	1,079,939	6.18
Virginia	145	15,907,673	576,920	312,553			128,395	[3] 309,452	17,234,993	3.43	12,177	98	2,386	14,661	278	4,070,626	4.23
Washington	46	849,683	69,280	399,090	12,096	479	11,933	14,683	1,357,244	5.12	951	100	324	1,375	273	375,945	3.61
West Virginia	1,058	133,414,315	[1]12,344,002	2,541,962	339,631	1,853,138	816,273	[3] 725,411	152,034,732	3.20	78,183	3,749	18,686	100,618	271	27,275,885	5.57
Wyoming	48	9,375,168	196,661	123,085	4,167		40,186	108,308	9,847,575	2.83	3,448	129	974	4,551	316	1,438,931	6.84
Grand total	7,033	469,483,480	[1]48,536,187	41,477,428	694,555	6,416,327	2,660,039	[2] 8,349,311	577,617,327	3.06	290,001	23,261	69,838	383,100	261	99,866,901	5.78

[1] Includes coal hauled by truck to waterway for shipment by water in following States in 1945: Illinois, 129,422 tons; Ohio, 110,808; Pennsylvania, 232,685; Tennessee, 115,164; and West Virginia, 808,014—a grand total of 1,396,093 tons.

[2] Includes coal made into beehive coke at mines in following States in 1945: Colorado, 129,837 tons; Kentucky, 124,153; Pennsylvania, 4,960,378; Utah, 7,889; Virginia, 284,785; and West Virgnia, 399,871—a grand total of 5,906,913 tons.

[3] Value received or charged for coal f. o. b. mine, including selling cost. (Includes a value for coal not sold but used by producer, such as mine fuel and coal coked [not coke] as estimated by producer, at average prices that might have been received if such coal had been sold commercially.)

[4] As it is necessary to conceal certain items in the lignite break-down of disposition of coal, the figures are shown here in column where greater part of concealed tonnage is included.

TABLE 18.—Number of mines, production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by districts, in 1945

[See Mineral Market Report 1468 for additional data by districts. Districts as defined in the Bituminous Coal Act of 1937 and modifications thereto. Exclusive of mines producing less than 1,000 tons]

Minimum price area and producing district	Number of active mines	Disposition of coal produced (net tons)								Average value per ton [3]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
		Loaded at mine directly into railroad cars or river barges	Hauled by truck to railroad siding for shipment by rail and to waterway for shipment by water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Taken by locomotive tenders at tipple	Shipped by conveyor or tram to point of consumption	Used by mine employees	Used at mines for power and heat and made into beehive coke at mines [2]	Total quantity		Underground	Surface		Total			
												In strip pits	All others				
PRICE AREA 1																	
District																	
1. Eastern Pennsylvania [4]	1,286	38,699,673	11,608,123	3,684,806	35,457	1,819,143	225,301	[2] 673,899	56,746,402	$3.41	32,692	4,814	7,530	45,036	253	11,414,403	4.97
2. Western Pennsylvania	790	55,788,229	[1] 9,084,363	7,398,160	152,360	1,459,492	354,814	[2] 4,830,566	79,067,984	3.21	42,167	3,398	7,902	53,467	260	13,893,334	5.69
3. Northern West Virginia	411	33,802,316	[1] 9,062,547	1,142,927	116,011	489,018	79,252	[2] 274,148	44,966,219	2.88	16,617	2,622	4,895	24,134	256	6,170,150	7.29
4. Ohio	535	23,799,192	[1] 3,049,682	5,757,247	-------	34,173	67,149	29,992	32,737,435	2.79	12,175	2,777	3,716	18,668	241	4,503,840	7.27
5. Michigan	3	49,803	-------	65,208	-------	-------	1,642	9,051	125,704	5.47	142	-------	31	173	268	46,341	2.71
6. Panhandle	38	2,310,434	[1] 505,796	655,592	206,133	894,329	18,016	18,739	4,609,039	2.93	2,316	224	431	2,971	265	787,191	5.86
7. Southern numbered 1	293	53,307,829	1,621,390	249,955	-------	150,539	443,141	[2] 233,686	56,006,531	3.53	35,689	683	7,430	43,802	282	12,364,376	4.53
8. Southern numbered 2	1,582	103,583,047	[1] 6,601,578	4,651,104	60,515	409,966	772,821	[2] 669,707	116,748,738	3.27	75,150	557	15,705	91,412	262	23,946,436	4.88
Total price area 1	4,938	311,340,514	41,533,479	23,604,999	570,476	5,256,660	1,962,136	6,739,788	391,008,052	3.23	216,948	15,075	47,640	279,663	261	73,126,071	5.35
PRICE AREA 2																	
9. West Kentucky	368	16,615,968	1,026,472	2,709,833	-------	17,349	30,102	44,648	20,444,372	2.18	6,755	694	2,030	9,479	252	2,388,342	8.56
10. Illinois	313	63,773,758	[1] 1,529,018	6,303,908	16,660	224,109	333,477	830,262	73,011,192	2.34	22,131	1,743	7,374	31,248	258	8,061,662	9.06
11. Indiana	134	21,674,200	722,767	2,147,033	7,541	466,833	37,911	126,326	25,182,611	2.32	5,296	1,830	2,646	9,772	241	2,351,205	10.71
12. Iowa	117	667,646	392,347	960,705	-------	-------	18,011	6,891	2,045,600	3.51	1,791	202	378	2,371	216	512,882	3.99
Total price area 2	932	102,731,572	3,670,604	12,121,479	24,201	708,291	419,501	1,008,127	120,683,775	2.33	35,973	4,469	12,428	52,870	252	13,314,091	9.06
PRICE AREA 3																	
13. Southeastern	447	15,938,343	[1] 1,571,608	1,483,847	65,609	295,802	103,309	92,719	19,551,237	4.14	18,113	976	3,660	22,749	267	6,065,482	3.22

PRICE AREA 4																
14. Arkansas-Oklahoma	93	1,618,855	552,673	79,466			4,102	6,035	2,261,131	5.01	2,114	453	507	3,074	213	654,484	3.45
PRICE AREA 5																
15. Southwestern:																
Bituminous	187	8,019,022	334,161	1,272,264	2,000	44,173	17,809	23,625	9,713,054	2.80	2,173	1,613	1,219	5,005	236	1,182,924	8.21
Lignite (Texas)	1	79,051			898				79,949	.85		19	7	26	158	4,096	19.52
Total price area 5	188	8,098,073	334,161	1,272,264	2,898	44,173	17,809	23,625	9,793,003	2.78	2,173	1,632	1,226	5,031	236	1,187,020	8.25
PRICE AREA 6																
16. Northern Colorado	31	1,474,299	10,686	776,487		36,320	15,147	37,665	2,350,604	3.42	1,479	8	294	1,781	236	421,006	5.58
17. Southern Colorado [5]	139	4,998,138	413,689	669,975	12,665	27,116	28,909	[2] 215,350	6,365,842	3.76	4,319	30	1,036	5,385	275	1,482,393	4.29
18. New Mexico [6]	23	248,262	14,376	84,891			3,834	40,742	392,105	4.55	427	8	148	583	230	134,315	2.92
Total price area 6	193	6,720,699	438,751	1,531,353	12,665	63,436	47,890	293,757	9,108,551	3.70	6,225	46	1,478	7,749	263	2,037,714	4.47
PRICE AREA 7																
19. Wyoming [7]	48	9,375,168	196,661	123,085	4,167		40,186	108,308	9,847,575	2.83	3,448	129	974	4,551	316	1,438,931	6.84
20. Utah	52	6,260,025	124,492	225,039	895		42,829	[2] 25,783	6,679,063	3.41	2,771		945	3,716	291	1,079,939	6.18
Total price area 7	100	15,635,193	321,153	348,124	5,062		83,015	134,091	16,526,638	3.06	6,219	129	1,919	8,267	305	2,518,870	6.56
PRICE AREA 8																
21. North-South Dakota (lignite)	57	2,023,257	5,360	[8] 449,530		[8] 47,486	([8])	21,131	2,546,764	1.56	231	293	248	772	227	175,132	14.54
PRICE AREA 9																
22. Montana (bituminous and lignite)	33	4,269,212	25,347	[8] 155,250	123		[8] 10,314	6,542	4,466,788	1.89	763	88	327	1,178	258	303,953	14.70
PRICE AREA 10																
23. Washington [9]	47	849,683	76,998	407,842	12,096	479	11,963	14,683	1,373,744	5.11	975	100	337	1,412	271	383,049	3.59
Alaska	5	258,079	6,053	23,274	1,425			8,813	297,644	6.28	267		68	335	302	101,035	2.95
Tota price area 10	52	1,107,762	83,051	431,116	13,521	479	11,963	23,496	1,671,388	5.31	1,242	100	405	1,747	277	484,084	3.45
Grand total [10]	7,033	469,483,480	[4] 8,536,187	41,477,428	694,555	6,416,327	2,660,039	[2] 8,349,311	577,617,327	3.06	290,001	23,261	69,838	383,100	261	99,866,901	5.78

[1] Includes coal hauled by truck to waterway for shipment by water in following districts in 1945; District 2, 232,685 tons; district 3, 646,388; district 4, 110,808; district 6, 59,071; district 8, 102,555; district 10, 129,422; and district 13, 115,164—a grand total of 1,396,093 tons.

[2] Includes coal made into beehive coke at mines in following districts in 1945: District 1, 239,420 tons; district 2, 4,720,958; district 3, 223,286; district 7, 55,146; district 8, 530,377; district 17, 129,837; and district 20, 7,889—a grand total of 5,906,913 tons.

[3] Value received or charged for coal f. o. b. mine, including selling cost. (Includes a value for coal not sold but used by producer, such as mine fuel and coal coked [not coke] as estimated by producer at average prices that might have been received if such coal had been sold commercially.)

[4] Includes Maryland and Grant, Mineral, and Tucker Counties, W. Va.

[5] Includes Colfax County, N. Mex.

[6] Includes Arizona and California, but excludes Colfax County, N. Mex. No production was reported for California.

[7] Includes Idaho. No production was reported for Idaho.

[8] As it is necessary to conceal certain items in the lignite break-down disposition of coal, the figures are shown here in column where greater part of concealed tonnage is included.

[9] Includes Oregon.

[10] For purposes of historical comparison and statistical convenience, figures include output of lignite and of anthracite and semianthracite outside of Pennsylvania.

PRODUCTION BY WEEKS AND MONTHS

TABLE 19.—Bituminous-coal and lignite production (final figures) in the United States in 1945, with estimates by weeks

Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)	Week ended—	Production (net tons)	Number of working days	Average production per working day (net tons)
Jan. 6	10,762,000	5.6	1,922,000	July 21	11,450,000	6	1,908,000
Jan. 13	12,387,000	6	2,065,000	July 28	11,968,000	6	1,995,000
Jan. 20	12,170,000	6	2,028,000	Aug. 4	11,243,000	6	1,874,000
Jan. 27	11,895,000	6	1,983,000	Aug. 11	11,524,000	6	1,921,000
Feb. 3	11,595,000	6	1,933,000	Aug. 18	6,221,000	4.6	1,352,000
Feb. 10	12,655,000	6	2,109,000	Aug. 25	12,210,000	6	2,035,000
Feb. 17	11,947,000	6	1,991,000	Sept. 1	12,287,000	6	2,048,000
Feb. 24	12,246,000	6	2,041,000	Sept. 8	10,043,000	5	2,009,000
Mar. 3	11,387,000	6	1,898,000	Sept. 15	12,355,000	6	2,059,000
Mar. 10	10,836,000	6	1,806,000	Sept. 22	11,815,000	6	1,969,000
Mar. 17	11,945,000	6	1,991,000	Sept. 29	11,074,000	6	1,846,000
Mar. 24	11,844,000	6	1,974,000	Oct. 6	8,172,000	6	1,362,000
Mar. 31	12,329,000	6	2,055,000	Oct. 13	6,234,000	6	1,039,000
Apr. 7	7,743,000	5.2	1,489,000	Oct. 20	5,961,000	6	994,000
Apr. 14	10,259,000	6	1,710,000	Oct. 27	12,237,000	6	2,040,000
Apr. 21	11,268,000	6	1,878,000	Nov. 3	12,522,000	6	2,087,000
Apr. 28	12,246,000	6	2,041,000	Nov. 10	12,523,000	6	2,087,000
May 5	10,766,000	6	1,794,000	Nov. 17	11,553,000	5.6	2,063,000
May 12	10,560,000	6	1,760,000	Nov. 24	10,373,000	5	2,075,000
May 19	11,266,000	6	1,878,000	Dec. 1	12,426,000	6	2,071,000
May 26	11,740,000	6	1,957,000	Dec. 8	12,314,000	6	2,052,000
June 2	11,165,000	5.5	2,030,000	Dec. 15	12,686,000	6	2,114,000
June 9	12,009,000	6	2,002,000	Dec. 22	11,150,000	6	1,858,000
June 16	11,780,000	6	1,963,000	Dec. 29	7,273,000	5	1,455,000
June 23	11,648,000	6	1,941,000	Jan. 5, 1946	[1] 1,717,000	[1] 1	[2] 2,013,000
June 30	11,797,000	6	1,966,000				
July 7	8,079,000	5	1,616,000		577,617,000	305.5	1,891,000
July 14	11,962,000	6	1,994,000				

[1] Figures represent output and number of working days in that part of week included in calendar year shown. Total production for week ended January 5, 1946, was 10,263,000 net tons.
[2] Average daily production for entire week and not for working days in calendar year shown.

TABLE 20.—Bituminous-coal and lignite production (final figures) in the United States in 1945, with estimates by months

Month	1945			Month	1945		
	Production (net tons)	Number of working days	Average production per working day (net tons)		Production (net tons)	Number of working days	Average production per working day (net tons)
January	53,134,000	26.6	1,998,000	August	47,802,000	25.6	1,867,000
February	48,280,000	24	2,012,000	September	47,067,000	24	1,961,000
March	52,584,000	27	1,948,000	October	39,260,000	27	1,454,000
April	43,490,000	24.2	1,797,000	November	50,926,000	24.6	2,070,000
May	49,620,000	26.5	1,872,000	December	46,955,000	25	1,878,000
June	51,137,000	26	1,967,000				
July	47,362,000	25	1,894,000	Total	577,617,000	305.5	1,891,000

TABLE 21.—Coal production in the United States, in 1945, by States (final figures), with estimates by months, in thousands of net tons

[Totals for year are based on final complete returns from all operators known to have produced more than 1,000 tons a year. Apportionment of known yearly total among the 12 months is based upon best information available; in some States upon direct tonnage reports by operators to State mine departments; in most cases upon current records of railway carloadings and waterway shipments]

State	January	February	March	April	May	June	July	August	September	October	November	December	Total
Alabama	1,645	1,389	1,617	852	1,735	1,625	1,525	1,567	1,577	1,711	1,579	1,414	18,236
Alaska	31	27	31	26	20	18	20	20	21	30	28	26	298
Arkansas	170	144	150	112	150	155	160	159	144	172	176	162	1,854
Colorado	759	728	761	564	517	519	501	556	579	736	680	721	7,621
Georgia	3	1	3	3	3	3	4	5	4	5	6	3	43
Illinois	6,976	6,252	6,738	5,597	5,794	6,141	5,436	5,567	5,817	6,724	6,100	5,869	73,011
Indiana	2,611	2,245	2,380	1,571	2,168	2,217	2,240	2,049	2,010	1,446	2,128	2,118	25,183
Iowa	199	193	196	127	155	155	153	173	159	208	171	157	2,046
Kansas	337	302	313	248	255	241	239	269	246	262	270	246	3,228
Kentucky:													
Eastern	4,862	4,444	4,601	3,603	4,645	4,393	3,906	3,888	4,116	2,261	4,485	3,945	49,149
Western	1,749	1,519	1,635	1,590	1,776	1,727	1,726	1,674	1,595	1,994	1,734	1,725	20,444
Total Kentucky	6,611	5,963	6,236	5,193	6,421	6,120	5,632	5,562	5,711	4,255	6,219	5,670	69,593
Maryland	145	133	162	133	145	146	140	139	139	163	166	152	1,763
Michigan	11	11	12	10	11	10	8	9	11	11	11	11	126
Missouri	416	373	386	306	314	298	294	332	304	323	333	304	3,983
Montana:													
Bituminous	450	380	442	321	347	356	345	351	308	342	375	408	4,425
Lignite	4	5	4	3	3	3	3	3	3	3	4	4	42
Total Montana	454	385	446	324	350	359	348	354	311	345	379	412	4,467
New Mexico	148	128	149	111	117	117	119	113	115	129	121	117	1,484
North Dakota (lignite)	295	232	167	125	136	156	156	150	182	287	314	322	2,522
Ohio	2,694	2,412	2,599	2,491	2,993	3,010	2,914	3,064	2,914	2,044	2,894	2,708	32,737
Oklahoma	266	227	236	175	235	244	251	249	227	271	275	253	2,909
Pennsylvania (bituminous)	11,484	10,780	12,210	9,947	11,560	12,546	11,496	11,423	10,742	8,081	11,728	10,968	132,965
South Dakota (lignite)	3	3	2	3	2	2	2	2	1	1	2	1	24
Tennessee	632	553	571	340	591	536	506	537	530	364	612	499	6,271
Texas (lignite)	13	10	8	5	7	5	5	4	5	6	7	5	80
Utah	663	593	623	535	546	542	513	505	488	553	583	535	6,679
Virginia	1,617	1,535	1,576	1,281	1,590	1,511	1,354	1,324	1,388	1,336	1,474	1,249	17,235
Washington	138	121	138	109	106	106	95	101	97	118	112	116	1,357
West Virginia	13,881	12,764	14,007	12,608	12,910	13,570	12,480	12,820	12,596	8,735	13,630	12,034	152,035
Wyoming	929	773	866	693	788	784	770	748	748	943	925	880	9,847
Other States [1]	3	3	1	1	1	1	1	1	1	1	3	3	20
Total, bituminous and lignite	53,134	48,280	52,584	43,499	49,620	51,137	47,362	47,802	47,067	39,260	50,926	46,955	577,617
Pennsylvania anthracite [2]	4,219	4,471	5,269	5,124	2,083	5,667	4,944	4,656	4,640	5,304	4,559	3,998	54,934
Grand total	57,353	52,751	57,853	48,614	51,703	56,804	52,306	52,458	51,707	44,564	55,485	50,953	632,551

[1] Includes Arizona and Oregon.

[2] Includes Sullivan County; also includes some "bootleg" coal purchased by legitimate operators and prepared at their breakers.

NUMBER AND SIZE OF MINES

TABLE 22.—Number and production of bituminous-coal and lignite mines in the United States, classified by size of output in each State, in 1945

[Exclusive of mines producing less than 1,000 tons]

State	Class 1A—more than 500,000 tons					Class 1B—200,000 to 500,000 tons					Class 2—100,000 to 200,000 tons				
	Mines		Production			Mines		Production			Mines		Production		
	Number	Percent	Total (net tons)	Average per mine (net tons)	Percent	Number	Percent	Total (net tons)	Average per mine (net tons)	Percent	Number	Percent	Total (net tons)	Average per mine (net tons)	Percent
Alabama	8	2.1	5,186,464	648,308	28.4	19	5.0	5,487,815	288,832	30.1	23	6.1	3,238,164	140,790	17.8
Alaska											2	40.0	209,199	104,600	70.3
Arizona															
Arkansas											2	3.0	243,645	121,823	13.1
Colorado	1	.6	578,948	578,948	7.6	4	2.4	1,083,944	270,986	14.2	22	13.3	3,196,486	145,295	41.9
Georgia															
Illinois	55	17.6	57,846,652	1,051,757	79.2	19	6.1	6,237,449	328,287	8.7	27	8.6	3,992,257	147,861	5.4
Indiana	20	14.9	16,832,049	841,602	66.8	12	9.0	4,114,483	342,874	16.3	17	12.7	2,388,368	140,492	9.5
Iowa						1	.9	218,384	218,384	10.7	2	1.7	272,564	136,282	13.3
Kansas	1	1.9	685,470	685,470	21.2	5	9.8	1,636,589	327,318	50.7	3	5.9	479,235	159,745	14.9
Kentucky	23	1.6	19,071,004	829,174	27.4	66	4.6	19,721,436	298,810	28.4	105	7.3	15,112,743	143,931	21.7
Maryland						1	1.1	260,698	260,698	14.8	1	1.1	148,824	148,824	8.4
Michigan															
Missouri	1	1.2	905,359	905,359	22.7	5	5.8	1,799,954	359,991	45.2	3	3.5	414,420	138,140	10.4
Montana (bituminous)	2	7.7	3,085,058	1,542,529	69.7	3	11.5	866,029	288,676	19.6	2	7.7	314,341	157,171	7.1
Montana, North Dakota, South Dakota, and Texas (lignite)						7	10.8	2,122,778	303,254	79.6					
New Mexico						3	11.5	964,846	321,615	65.1	2	7.7	274,527	137,264	18.5
Ohio	15	2.8	13,552,374	903,492	41.4	21	3.9	6,911,365	329,113	21.1	35	6.5	5,140,714	146,878	15.7
Oklahoma						4	5.3	1,041,495	260,374	35.8	6	7.9	753,806	125,634	25.9
Oregon															
Pennsylvania	63	3.2	55,921,121	887,637	42.1	85	4.4	25,942,508	305,206	19.5	129	6.6	17,680,270	137,056	13.3
Tennessee						9	6.4	2,448,145	272,016	39.0	10	7.1	1,491,003	149,100	23.8
Utah	4	7.7	3,444,862	861,216	51.6	7	13.4	2,171,219	310,174	32.5	4	7.7	528,238	132,060	7.9
Virginia	7	4.8	6,056,425	865,204	35.1	17	11.7	6,107,977	359,293	35.4	21	14.5	3,186,580	151,742	18.5
Washington											5	10.9	670,480	134,096	49.4
West Virginia	70	6.6	54,787,319	782,676	36.0	182	17.2	56,517,432	310,535	37.2	163	15.4	23,765,034	145,798	15.6
Wyoming	7	14.6	6,502,979	928,997	66.0	6	12.5	1,897,151	316,192	19.3	7	14.6	856,496	122,357	8.7
Total	277	3.9	244,456,084	882,513	42.3	476	6.8	147,551,697	309,983	25.5	591	8.4	84,357,394	142,737	14.6

State	Class 3—50,000 to 100,000 tons					Class 4—10,000 to 50,000 tons					Class 5—less than 10,000 tons					Total		
	Mines		Production			Mines		Production			Mines		Production			Mines	Production (net tons)	
	Number	Percent	Total (net tons)	Average per mine (net tons)	Percent	Number	Percent	Total (net tons)	Average per mine (net tons)	Percent	Number	Percent	Total (net tons)	Average per mine (net tons)	Percent		Total	Average per mine
Alabama	22	5.9	1,559,517	70,887	8.6	81	21.5	1,953,083	24,112	10.7	224	59.4	811,496	3,623	4.4	377	18,236,539	48,373
Alaska	1	20.0	57,498	57,498	19.3	1	20.0	22,421	22,421	7.5	1	20.0	8,526	8,526	2.9	5	297,644	59,529
Arizona											1	100.0	3,853	3,853	100.0	1	3,853	3,853
Arkansas	15	22.4	1,015,279	67,685	54.8	20	29.8	485,595	24,280	26.2	30	44.8	109,407	3,647	5.9	67	1,853,926	27,671
Colorado	18	10.8	1,287,183	71,510	16.9	43	25.9	1,133,472	26,360	14.9	78	47.0	340,979	4,372	4.5	166	7,621,012	45,910
Georgia						2	66.7	39,568	19,784	93.0	1	33.3	3,000	3,000	7.0	3	42,568	14,189
Illinois	28	8.9	1,967,424	70,265	2.7	96	30.7	2,574,838	26,821	3.5	88	28.1	392,572	4,461	.5	313	73,011,192	233,263
Indiana	14	10.4	986,751	70,482	3.9	30	22.4	697,051	23,235	2.8	41	30.6	163,909	3,998	.7	134	25,182,611	187,930
Iowa	6	5.1	427,799	71,300	20.9	40	34.2	809,966	20,249	39.6	68	58.1	316,887	4,660	15.5	117	2,045,600	17,484
Kansas						13	25.5	307,361	23,643	9.5	29	56.9	119,904	4,135	3.7	51	3,228,559	63,305
Kentucky	79	5.5	5,233,095	66,242	7.5	341	23.6	7,190,077	21,085	10.3	827	57.4	3,264,581	3,947	4.7	1,441	69,592,936	48,295
Maryland	7	7.4	570,643	81,520	32.4	20	21.3	537,085	26,854	30.5	65	69.1	245,453	3,776	13.9	94	1,762,703	18,752
Michigan	1	33.3	93,028	93,028	74.0	2	66.7	32,676	16,338	26.0						3	125,704	41,901
Missouri	3	3.5	189,023	63,008	4.8	20	23.2	451,124	22,556	11.3	54	62.8	222,844	4,127	5.6	86	3,982,724	46,311
Montana (bituminous)	1	3.9	55,710	55,710	1.3	2	7.7	36,991	18,496	.8	16	61.5	67,062	4,191	1.5	26	4,425,191	170,200
Montana, North Dakota, South Dakota, and Texas (lignite)	3	4.6	192,967	64,322	7.2	10	15.4	203,146	20,315	7.6	45	69.2	149,419	3,320	.6	65	2,668,310	41,051
New Mexico	1	3.9	70,143	70,143	4.7	4	15.4	114,677	28,669	7.7	16	61.5	59,493	3,718	4.0	26	1,483,686	57,065
Ohio	33	6.2	2,424,935	73,483	7.4	149	27.9	3,628,697	24,354	11.1	282	52.7	1,079,350	3,827	3.3	535	32,737,435	61,191
Oklahoma	9	11.8	641,336	71,260	22.1	16	21.1	313,971	19,623	10.8	41	53.9	158,368	3,863	5.4	76	2,908,976	38,276
Oregon						1	100.0	16,500	16,500	100.0						1	16,500	16,500
Pennsylvania	206	10.5	14,512,104	70,447	10.9	668	34.0	15,447,891	23,195	11.6	808	41.3	3,461,449	4,284	2.6	1,957	132,965,343	67,943
Tennessee	21	15.0	1,223,765	58,272	19.5	39	27.9	852,959	21,871	13.6	61	43.6	254,896	4,179	4.1	140	6,270,708	44,791
Utah	3	5.8	200,079	66,693	3.0	13	25.0	271,097	20,854	4.0	21	40.4	63,568	3,027	1.0	52	6,679,063	128,444
Virginia	11	7.6	825,479	75,044	4.8	34	23.5	818,678	24,079	4.8	55	37.9	239,854	4,361	1.4	145	17,234,993	118,862
Washington	3	6.5	171,180	57,060	12.6	18	39.1	425,134	23,619	31.3	20	43.5	90,450	4,523	6.7	46	1,357,244	29,505
West Virginia	137	13.0	9,630,128	70,293	6.3	256	24.2	6,340,040	24,766	4.2	250	23.6	994,779	3,979	.7	1,058	152,034,732	143,700
Wyoming	7	14.6	421,487	60,212	4.3	3	6.2	111,084	37,028	1.1	18	37.5	58,378	3,243	.6	48	9,847,575	205,158
Total	629	8.9	43,756,493	69,565	7.6	1,920	27.3	44,815,182	23,341	7.8	3,140	44.7	12,680,477	4,038	2.2	7,033	577,617,327	82,130

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AVERAGE VALUE

Before the Bituminous Coal Act of 1937 was passed, the most valuable single index of the trend of prices at the mines was the "average value per ton, f. o. b. mines," as given in the familiar annual coal reports of the Bureau of Mines, United States Department of the Interior. This series was referred to in Bureau of Mines reports as representing "bituminous coal," and it covered all coal (other than Pennsylvania anthracite) produced in the United States. It represented the bituminous-coal industry as the term ordinarily was used in the trade and included the lignite of the Dakotas, Texas, and Montana, as well as any small tonnages of hard coal produced outside of Pennsylvania.

With the passage of the Coal Act, the Bureau of Mines relinquished the collection of statistics relating to bituminous coal, effective June 30, 1937,[1] though continuing to compile data regarding lignite and Pennsylvania anthracite. Effective the same date, the Coal Commission became responsible for the compilation of data on bituminous coal, though not attempting to collect data regarding lignite, which was specifically exempted by the Act. The records of the Commission (later the Bituminous Coal Division, United States Department of the Interior) relate to all coal other than Pennsylvania anthracite, Virginia semianthracite, and lignite.

To permit comparison of the old and new series, therefore, it is necessary to separate the lignites from the bituminous coals, though the combined average for the two is continued in a form as nearly comparable as possible to the old series (see table 23).

A more important change in the two series relates to the treatment of selling expenses. The old Bureau of Mines series of "value at the mines" excluded the selling cost. Reporting operators were asked to state the "Amount received at the mines f. o. b. cars less the selling expense." No details were asked regarding the items included in the value, and no systematic effort was made to follow up the exclusion of selling expenses. It was realized at the time that some producers might find it impractical to exclude selling costs and that some part of the selling expenses of the industry might be included in the results. Nevertheless, the reports were checked for consistency from year to year, the questions were retained in the same form without change, and the results are believed to have been comparable from one year to the next. The new series of the Coal Commission represents the total or gross realization on all coal produced and specifically includes the selling cost.

The two sets of data may not be precisely comparable with respect to coal produced but not sold on the commercial market. In the Bureau of Mines series reporting operators were instructed that the "value of coal not sold but used by producer, also mine fuel and coal made into coke, should be estimated at average prices that might have been received." The instructions of the Coal Commission regarding such items were in effect similar, though given in greater detail.

A comparison of the two series is possible for 1936. In that year, the average value per ton on the old (Bureau of Mines) basis amounted to $1.761 per ton for bituminous coal, excluding lignite. The average gross realization, according to data collected by the Coal Commission, was $1.831 per ton. The difference amounts to $0.07 per ton—an

amount somewhat less than the average selling expenditure computed per ton of all coal produced, as reported to the Coal Commission. The comparison confirms previous indications that the great majority of operators reporting in earlier years had followed instructions and omitted selling expenses in computing the average value but that some of them had included the selling expense. The change in method of reporting should be kept in mind in comparing the two sets of data. As the reports to the Commission were submitted on a detailed accounting return and made under oath, they are to be accepted. The returns of earlier years, upon a voluntary basis and not in all instances uniform as to treatment of selling costs, seem to have been thoroughly comparable from one year to the next and afford the best available index to the rise and fall of the mine prices received by operators down to 1936.

TABLE 23.—Trend of average value in the United States of bituminous coal and lignite per ton, f. o. b. mines, 1929–45

Year	Bituminous coal (subject to regulation under 1937 Act)[1]	Lignite [2]	Total
Average value per ton less selling cost:			
1929	$1.782	$1.548	$1.781
1930	1.702	1.556	1.701
1931	1.542	1.410	1.541
1932	1.313	1.313	1.313
1933	1.337	1.188	1.336
1934	1.751	1.387	1.749
1935	1.772	1.120	1.767
1936	1.761	1.061	1.756
Average gross realization, selling cost not deducted:			
1936	1.831	[3] 1.061	1.826
1937	1.946	[3] 1.080	1.939
1938	1.955	[3] 1.071	1.947
1939 [4]	1.850	1.158	1.845
1940	1.913	[3] 1.156	1.908
1941	2.194	1.237	2.189
1942	2.363	1.364	2.358
1943	2.691	1.490	2.685
1944	2.929	1.487	2.923
1945	3.068	1.553	3.061

[1] Includes all coal produced other than Pennsylvania anthracite and lignite included in second column.
[2] North Dakota, South Dakota, and lignite counties of Montana and Texas.
[3] Figures for 1936–38 and 1940 exclude selling cost as before.
[4] Producers were asked to exclude selling cost in reporting value, but a number of them included such costs.

LABOR STATISTICS

Men Employed.—An average of 383,100 men was employed at bituminous-coal and lignite mines in 1945, a 2.6 percent decrease from the total of 393,347 for 1944 (see fig. 10).

The method used here in calculating employment gives an accurate measure of the working force in the coal industry but does not consider the time lost by men on the rolls through intermittent operations. To measure the influence of intermittency upon employment the factor of mine activity as indicated by the average number of days of plant operation was recorded separately. The average number of men on the rolls when the mines were in operation was then used, in conjunction with the average number of days of operation, as a measure of the total volume of employment in the industry.

Days Operated.—The average number of days of operation at bituminous-coal and lignite mines in 1945 was 261. This represents a decrease from the average of 278 days for 1944. All statistics on days of mine operation included in this report are weighted averages, in which the operating time of each mine has been weighted by the number of its employees. Several coal-mining States publish series on the number of days worked that are simple averages of the figures for each reporting mine, regardless of size. As these unweighted averages are likely to be unduly depressed by small mines, which generally operate fewer days than the larger ones, they tend to understate the working time of a typical mine employee.

Man-Days of Labor.—Man-days have been computed by multiplying the number of workers employed by the number of operating days. Although these computations were made for each individual mine, the combined total is necessarily only an approximation.

Data for 1945 indicate that bituminous-coal and lignite-mine employees performed 99,866,901 man-days of labor during the year. Table 17 gives a summary record of men employed, days operated,

TABLE 24.—Number of bituminous-coal and lignite mines in the United States having established working shift of certain length and number of men employed therein in 1945

State	7 hours		8 hours		9 hours		All others [1]		Total	
	Mines	Men	Mines	Men	Mines	Men	Mines	Men	Mines	Men
Alabama	69	1,413	285	17,029	14	1,045	9	1,494	377	20,981
Alaska			4	250			1	85	5	335
Arizona			1	8					1	8
Arkansas			51	1,619	6	354	10	403	67	2,376
Colorado	18	132	119	5,695	12	179	17	424	166	6,430
Georgia			3	89					3	89
Illinois	144	10,526	152	20,125	1	20	16	577	313	31,248
Indiana	24	722	103	8,627	1	244	6	179	134	9,772
Iowa	12	181	85	1,871	6	48	14	271	117	2,371
Kansas	9	107	37	1,160	1	40	4	195	51	1,502
Kentucky:										
Eastern	22	363	1,010	38,056	27	2,158	14	2,502	1,073	43,079
Western	14	303	348	8,370	4	641	2	165	368	9,479
Total Kentucky	36	666	1,358	46,426	31	2,799	16	2,667	1,441	52,558
Maryland	10	48	64	1,040	14	410	6	237	94	1,735
Michigan	2	64			1	109			3	173
Missouri	14	211	69	1,724	1	9	2	27	86	1,971
Montana:										
Bituminous	2	6	21	883	2	15	1	234	26	1,138
Lignite	2	9	5	31					7	40
Total Montana	4	15	26	914	2	15	1	234	33	1,178
New Mexico	3	29	19	1,166			4	116	26	1,311
North Dakota (lignite)	2	29	35	482	3	17	13	229	53	757
Ohio	86	1,378	381	14,758	9	524	59	2,008	535	18,668
Oklahoma	10	59	53	1,459	7	301	6	411	76	2,230
Oregon							1	37	1	37
Pennsylvania	389	4,854	1,282	64,466	98	3,390	188	23,226	1,957	95,936
South Dakota (lignite)			3	13	1	2			4	15
Tennessee	34	545	101	5,742			5	185	140	6,472
Texas (lignite)			1	26					1	26
Utah	8	94	40	3,503	2	46	2	73	52	3,716
Virginia	15	110	115	13,511	7	311	8	729	145	14,661
Washington	7	43	32	1,176	3	37	4	119	46	1,375
West Virginia	118	2,675	783	77,942	49	3,413	108	16,588	1,058	100,618
Wyoming	6	56	38	4,383	2	69	2	43	48	4,551
Total	1,020	23,957	5,240	295,204	271	13,382	502	50,557	7,033	383,100

[1] Includes mines where the day was more than 9 or less than 7 hours or was irregular.

and output per man per day at bituminous-coal and lignite mines, by States, in 1945. Details by counties for 1945 are shown in table 44.

Length of Working Day.—Table 24 summarizes the replies of mine operators to the question, "Number of hours operated per shift."

The established working day does not of itself measure the length of time that men actually work or the time that they are underground, because of the possibility of overtime, because the mine may sometimes shut down before the full day is over, because the miner may go home before the mine stops, and because he spends a considerable time going to and from his place of work underground. These figures represent the operator's statement of the nominal operating day for the mine. They do not purport to represent the time actually worked by the men. On the one hand, they make no allowance for tonnage or piece workers who leave early; on the other hand, they make no allowance for tonnage men who continue at work after the mine as a whole is shut down, or who go into the mine to work on days when the tipple is idle.

It was found that 77 percent of the men employed were in 8-hour mines and that the weighted average working shift was 7.9 hours.

BITUMINOUS COAL AND LIGNITE LOADED FOR SHIPMENT BY INDIVIDUAL RAILROADS AND WATERWAYS

TABLE 25.—Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, as reported by mine operators, in 1945[1]

Route	State	Net tons	
		By State	Total for route
RAILROADS			
Alabama Central	Alabama	118,280	118,280
Alabama Great Southern	do	230,710	230,710
Alaska	Alaska	264,132	264,132
Algiers, Winslow & Western	Indiana	2,812,726	2,812,726
Alton	Illinois	1,072,262	1,072,262
Artemus-Jellico	Kentucky	465,489	465,489
Atchison, Topeka & Santa Fe	Colorado	344,791	2,621,990
	Illinois	810,775	
	Kansas	497,926	
	Missouri	1,000	
	New Mexico	967,498	
Baltimore & Ohio	Illinois	463,326	51,434,320
	Indiana	713,110	
	Maryland	18,063	
	Ohio	4,949,894	
	Pennsylvania	13,839,131	
	West Virginia	31,450,806	
Bessemer & Lake Erie	Pennsylvania	3,401,445	3,401,445
Bevier & Southern	Missouri	427,583	427,583
Brimstone	Tennessee	58,400	58,400
Buffalo Creek & Gauley	West Virginia	855,757	855,757
Cambria & Indiana	Pennsylvania	3,926,745	3,926,745
Campbell's Creek	West Virginia	849,272	849,272
Carbon County	Utah	1,502,464	1,502,464
Central of Georgia	Alabama	861,179	899,880
	Georgia	38,701	
Chesapeake & Ohio	Kentucky	12,953,305	60,239,280
	Ohio	1,206,935	
	West Virginia	46,079,040	
Cheswick & Harmar	Pennsylvania	903,157	903,157
Chicago, Attica & Southern	Indiana	3,760	3,760

See footnote at end of table.

TABLE 25.—Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, as reported by mine operators, in 1945 [1]—Con.

Route	State	Net tons	
		By State	Total for route
RAILROADS—continued			
Chicago, Burlington & Quincy	Colorado	373,987	13,155,840
	Illinois	10,949,111	
	Iowa	289,851	
	Missouri	44,284	
	Wyoming	1,498,607	
Chicago & Eastern Illinois	Illinois	3,464,236	5,377,453
	Indiana	1,913,217	
Chicago & Illinois Midland	Illinois	6,366,103	6,366,103
Chicago, Indianapolis & Louisville	Indiana	805,622	805,622
Chicago, Milwaukee, St. Paul & Pacific	do	6,149,709	7,518,567
	Iowa	287,518	
	Missouri	4,628	
	Montana (bituminous)	1,030,613	
	North Dakota (lignite)	33,739	
	South Dakota (lignite)	5,360	
	Washington	7,000	
Chicago & North Western	Illinois	3,203,937	3,203,937
Chicago, Rock Island & Pacific	Arkansas	47,127	1,018,071
	Illinois	540,158	
	Iowa	96,643	
	Missouri	226,419	
	Oklahoma	107,724	
Cleveland, Cincinnati, Chicago, & St. Louis	Illinois	4,725,917	7,639,598
	Indiana	2,913,681	
Clinchfield	Kentucky	65,831	2,754,926
	Virginia	2,689,095	
Colorado & Southeastern	Colorado	125,958	125,958
Colorado & Southern	do	502,729	502,729
Colorado & Wyoming	do	576,113	576,113
Conemaugh & Black Lick	Pennsylvania	83,195	83,195
Cumberland & Pennsylvania	Maryland	469,106	469,106
Dardanelle & Russellville Ry. Co	Arkansas	73,325	73,325
Denver & Intermountain	Colorado	107,905	107,905
Denver & Rio Grande Western	do	1,760,635	5,025,232
	New Mexico	14,280	
	Utah	3,250,317	
Denver & Salt Lake	Colorado	1,097,260	1,097,260
Detroit, Toledo & Ironton	Ohio	10,420	10,420
East Broad Top Railroad & Coal Co	Pennsylvania	539,093	539,093
Erie	Ohio	69,281	831,949
	Pennsylvania	762,668	
Evansville & Ohio Valley	Indiana	22,648	22,648
Evansville, Suburban & Newburgh	do	249,215	249,215
Fort Dodge, Des Moines & Southern	Iowa	41,158	41,158
Fort Smith & Van Buren	Oklahoma	133,366	133,366
Galesburg & Great Eastern	Illinois	500,878	500,878
Great Northern	Montana (bituminous)	186,879	832,265
	North Dakota (lignite)	574,532	
	Washington	70,854	
Gulf, Mobile & Ohio	Alabama	275,895	1,697,114
	Illinois	1,421,219	
Harriman & Northeastern	Tennessee	60,100	60,100
Huntingdon & Broad Top Mountain Railroad & Coal Co.	Pennsylvania	737,432	737,432
Illinois Central	Alabama	197,882	25,547,694
	Illinois	14,950,449	
	Indiana	78,549	
	Kentucky	10,320,814	
Illinois Terminal	Illinois	492,769	492,769
Interstate	Kentucky	135,829	2,800,348
	Virginia	2,664,519	
Iowa Southern Utilities Co	Iowa	75,105	75,105
Johnstown & Stony Creek	Pennsylvania	264,916	264,916
Joplin-Pittsburg	Kansas	412,068	412,068
Kanawha Central	West Virginia	107,005	107,005
Kansas City Southern	Arkansas	64,580	910,905
	Missouri	815,709	
	Oklahoma	30,616	
Kansas, Oklahoma & Gulf	do	12,561	12,561
Kelley's Creek & Northwestern	West Virginia	1,108,204	1,108,204
Kentucky & Tennessee	Kentucky	830,314	830,314
Lake Erie, Franklin & Clarion	Pennsylvania	260,225	260,225
Laramie, North Park & Western	Colorado	6,400	6,400
Ligonier Valley	Pennsylvania	105,456	105,456
Litchfield & Madison	Illinois	745,252	745,252

See footnote at end of table.

TABLE 25.—Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, as reported by mine operators, in 1945 [1]—Con.

Route	State	Net tons	
		By State	Total for route
RAILROADS—continued			
Louisville and Nashville	Alabama	3,463,307	35,102,419
	Illinois	113,124	
	Kentucky	30,428,109	
	Tennessee	905,248	
	Virginia	192,631	
Mary Lee	Alabama	673,734	673,734
Midland Valley	Arkansas	254,516	511,195
	Oklahoma	256,679	
Minneapolis & St. Louis	Illinois	2,434,782	2,506,912
	Iowa	72,130	
Minneapolis, St. Paul & Sault Ste. Marie	North Dakota (lignite)	609,341	609,341
Missouri-Illinois	Illinois	18,454	18,454
Missouri-Kansas-Texas	Kansas	247,553	945,502
	Missouri	298,172	
	Oklahoma	399,777	
Missouri Pacific	Arkansas	1,005,117	10,467,741
	Illinois	7,743,363	
	Kansas	1,059,512	
	Missouri	411,849	
	Oklahoma	247,900	
Monessen Southwestern	Pennsylvania	19,045	19,045
Monongahela	do	3,142,075	10,913,072
	West Virginia	7,770,997	
Montana, Wyoming & Southern	Montana (bituminous)	524,664	524,664
Montour	Pennsylvania	6,665,433	6,665,433
Nashville, Chattanooga & St. Louis	Alabama	2,334	847,787
	Tennessee	845,453	
New York Central (includes coal shipped over Kanawa and Michigan, Kelley's Creek, Toledo and Ohio Central, and Zanesville and Western)	Ohio	7,010,475	14,227,456
	Pennsylvania	5,534,768	
	West Virginia	1,682,213	
Nicholas, Fayette & Greenbrier	do	2,865,755	2,865,755
Norfolk & Western	Kentucky	5,515,663	46,372,693
	Virginia	9,679,348	
	West Virginia	31,177,682	
Northern Pacific	Montana (bituminous)	2,552,403	4,031,382
	North Dakota (lignite)	805,645	
	Washington	673,334	
Oklahoma City-Ada-Atoka	Oklahoma	275,266	275,266
Oneida & Western	Tennessee	10,000	10,000
Pacific Coast	Washington	110,086	110,086
Pennsylvania (includes Pittsburgh, Cincinnati, Chicago and St. Louis)	Illinois	147,138	53,537,712
	Indiana	4,732,453	
	Ohio	6,369,520	
	Pennsylvania	41,777,919	
	West Virginia	510,682	
Peoria Terminal	Illinois	382,011	382,011
Pere Marquette	Michigan	49,803	49,803
Pittsburg & Lake Erie	Pennsylvania	2,534,023	2,534,023
Pittsburg & Shawmut	do	2,476,150	2,476,150
Pittsburg, Shawmut & Northern	do	287,756	287,756
Pittsburgh, Chartiers & Youghiogheny	do	50,664	50,664
Pittsburgh, Lisbon & Western	Ohio	10,319	10,319
Pittsburgh & West Virginia	do	910,985	2,308,081
	Pennsylvania	1,148,899	
	West Virginia	248,197	
Preston	do	83,267	83,267
Rio Grande Southern	Colorado	11,915	11,915
Rockdale, Sandow & Southern	Texas (lignite)	79,051	79,051
St. Louis & O'Fallon	Illinois	367,370	367,370
St. Louis-San Francisco	Alabama	2,212,768	4,970,272
	Arkansas	337,360	
	Kansas	783,461	
	Missouri	378,838	
	Oklahoma	1,257,845	
Seaboard Air Line	Alabama	35,861	35,861
Southern	do	3,504,989	10,574,628
	Illinois	130,684	
	Indiana	2,002,277	
	Kentucky	1,369,952	
	Tennessee	2,474,154	
	Virginia	1,092,572	
Southern Pacific	New Mexico	360,517	368,235
	Oregon	7,718	
Springfield & Southwestern	Illinois	58,355	58,355
Springfield Terminal	do	852,735	852,735

See footnote at end of table.

TABLE 25.—Bituminous coal and lignite loaded for shipment by railroads and waterways in the United States, as reported by mine operators, in 1945 [1]—Con.

Route	State	Net tons	
		By State	Total for route
RAILROADS—continued			
Tennessee	Tennessee	985,703	985,703
Tennessee Central	do	389,188	389,188
Tennessee Coal, Iron & Railroad Co	Alabama	2,923,495	2,923,495
Thomas & Sayreton	do	501,780	501,780
Toledo, Peoria & Western	Illinois	45,568	45,568
Union	Pennsylvania	482,518	482,518
Union Pacific	Colorado	909,462	9,044,802
	Utah	4,429	
	Washington	57,689	
	Wyoming	8,073,222	
Unity	Pennsylvania	744,518	744,518
Utah	Utah	1,627,307	1,627,307
Virginian	Virginia	166,428	12,401,244
	West Virginia	12,234,816	
Wabash	Illinois	2,766,029	3,375,567
	Iowa	197,588	
	Missouri	411,950	
West Virginia Northern	West Virginia	646,526	646,526
Western Allegheny	Pennsylvania	278,987	278,987
Western Maryland	Maryland	970,130	5,938,384
	Pennsylvania	376,660	
	West Virginia	4,591,594	
Wheeling & Lake Erie	Ohio	5,880,848	5,880,848
Winifrede	West Virginia	210,221	210,221
Woodward Iron Co	Alabama	923,872	923,872
Youngstown & Suburban	Ohio	11,853	11,853
Total railroad shipments		490,471,988	490,471,988
WATERWAYS			
Allegheny River	Pennsylvania	1,092,975	1,092,975
Black Warrior River	Alabama	433,772	433,772
Cheat River	Pennsylvania	784	784
Illinois River	Illinois	536,771	536,771
Kanawha River	West Virginia	1,486,566	1,486,566
Monongahela River	Pennsylvania	21,285,503	22,366,501
	West Virginia	1,080,998	
Muskingum River	Ohio	307,536	307,536
Ohio River	Kentucky	378,083	1,207,610
	Ohio	110,808	
	West Virginia	718,719	
Tennessee River	Tennessee	115,164	115,164
Total waterway shipments		27,547,679	27,547,679
Total loaded at mines for shipment by railroads and waterways		518,019,667	518,019,667
Shipped by truck or wagon		41,477,428	41,477,428
Taken by locomotive tender at tipple		694,555	694,555
Shipped by conveyor or tram to point of consumption		6,416,327	6,416,327
Coal used by employees		2,660,039	2,660,039
Used at mine for power and heat		2,442,398	2,442,398
Made into beehive coke at mine		5,906,913	5,906,913
Total production		577,617,327	577,617,327

[1] Includes coal loaded at mine directly into railroad cars or river barges, hauled by truck to railroad siding for shipment by rail, and hauled by truck to waterway for shipment by water. In general, figures show quantity of bimuminous coal and lignite originated for each railroad and waterway as reported by mine operators. It must be noted that in one year an operator may report coal loaded on subsidiary railroad and in another year same operator may report coal loaded on parent railroad system.

METHODS OF RECOVERY

TABLE 26.—Bituminous coal and lignite mined by different methods in the United States, by States, in 1945

State	From underground workings							From strip pits		Grand total production (net tons)
	Mined by hand		Shot from the solid		Cut by machines		Total underground (net tons)	Net tons	Percent of grand total	
	Net tons	Percent of total underground	Net tons	Percent of total underground	Net tons	Percent of total underground				
Alabama	261,012	1.6	3,596,614	22.0	12,488,094	76.4	16,345,720	1,890,819	10.4	18,236,539
Alaska			297,644	100.0			297,644			297,644
Arizona			3,853	100.0			3,853			3,853
Arkansas	16,104	1.4	110,500	9.3	1,055,498	89.3	1,182,102	671,824	36.2	1,853,926
Colorado	1,177,185	15.6	191,028	2.5	6,199,988	81.9	7,568,201	52,811	.7	7,621,012
Georgia			32,347	100.0			32,347	10,221	24.0	42,568
Illinois	61,789	.1	2,682,787	4.8	53,357,516	95.1	56,102,092	16,909,100	23.2	73,011,192
Indiana	55,371	.5	223,072	1.9	11,440,079	97.6	11,718,522	13,464,089	53.5	25,182,611
Iowa	49,689	3.3	560,984	36.8	913,869	59.9	1,524,542	521,058	25.5	2,045,600
Kansas	49,078	18.0	24,295	8.9	199,686	73.1	273,059	2,955,500	91.5	3,228,559
Kentucky	1,353,152	2.2	7,170,064	11.4	54,374,881	86.4	62,898,097	6,694,839	9.6	69,592,936
Maryland	960,233	62.1			584,944	37.9	1,545,177	217,526	12.3	1,762,703
Michigan					125,704	100.0	125,704			125,704
Missouri	29,780	6.1	61,129	12.4	399,513	81.5	490,422	3,492,302	87.7	3,982,724
Montana (bituminous)	3,320	.2	6,699	.3	1,859,964	99.5	1,869,983	2,555,208	57.7	4,425,191
Montana (lignite)			40,464	100.0			40,464	1,133	2.7	41,597
New Mexico	164,271	11.1	197,634	13.3	1,120,301	75.6	1,482,206	1,480	.1	1,483,686
North Dakota (lignite)	12,943	1.9	26,168	4.0	623,534	94.1	662,645	1,859,674	73.7	2,522,319
Ohio	79,202	.4	86,093	.5	19,088,351	99.1	19,253,646	13,483,789	41.2	32,737,435
Oklahoma	1,351	.1	106,487	8.3	1,172,720	91.6	1,280,558	1,628,418	56.0	2,908,976
Oregon			200	1.2	16,300	98.8	16,500			16,500
Pennsylvania	10,315,628	9.8	3,533,278	3.4	91,408,767	86.8	105,257,673	27,707,670	20.8	132,965,343
South Dakota (lignite)			3,033	100.0			3,033	21,412	87.6	24,445
Tennessee	280,727	4.6	1,128,605	18.6	4,654,913	76.8	6,064,245	206,463	3.3	6,270,708
Texas (lignite)								79,949	100.0	79,949
Utah	11,666	.2	68,424	1.0	6,598,973	98.8	6,679,063			6,679,063
Virginia	156,237	.9	1,032,853	6.1	15,737,013	93.0	16,926,103	308,890		17,234,993
Washington	94,444	7.8	537,137	44.6	573,852	47.6	1,205,433	151,811	11.2	1,357,244
West Virginia	3,492,432	2.5	2,295,132	1.7	132,000,913	95.8	137,788,477	14,246,255	9.4	152,034,732
Wyoming	132,983	1.5	128,909	1.4	8,731,059	97.1	8,992,951	854,624	8.7	9,847,575
Total	18,758,597	4.0	24,145,433	5.2	424,726,432	90.8	467,630,462	109,986,865	19.0	577,617,327

TABLE 27.—Number of coal-cutting machines in bituminous-coal and lignite mines, average output per machine, and percentage of total product of underground mines cut by machines in the United States, by States, 1944–45

State	1944					1945				
	Number of coal-cutting machines in use			Average output per machine (net tons)	Percent of total product of underground mines cut by machines	Number of coal-cutting machines in use			Average output per machine (net tons)	Percent of total product of underground mines cut by machines
	Permissible	Other	Total			Permissible	Other	Total		
Alabama	268	326	594	23,034	77.9	291	350	641	19,482	76.4
Alaska	2		2	673	4					
Arkansas	27	61	88	13,065	86.0	26	52	78	13,532	89.3
Colorado	175	321	496	12,825	78.0	202	313	515	12,039	81.9
Illinois	287	541	828	67,402	94.9	289	512	801	66,614	95.1
Indiana	64	185	249	54,355	97.8	95	144	239	47,866	97.6
Iowa	43	43	86	11,343	59.9	33	46	79	11,568	59.9
Kansas	13	13	26	7,861	70.7	8	12	20	9,984	73.1
Kentucky	553	1,119	1,672	34,823	88.1	572	1,178	1,750	31,071	86.4
Maryland	21	26	47	14,040	38.0	21	27	48	12,186	37.9
Michigan	4	16	20	6,997	100.0		18	18	6,984	100.0
Missouri	23	45	68	8,968	83.7	28	30	58	6,888	81.5
Montana (bituminous)	10	54	64	35,334	99.2	7	50	57	32,631	99.5
New Mexico	41	36	77	14,815	65.4	41	36	77	14,549	75.6
North Dakota (lignite)	10	5	15	44,123	93.3	13	3	16	38,971	94.1
Ohio	325	519	844	26,102	99.2	262	523	785	24,316	99.1
Oklahoma	71	75	146	9,674	90.7	70	58	128	9,162	91.6
Oregon						2		2	8,150	98.8
Pennsylvania	2,356	1,075	3,431	30,833	85.6	2,304	1,096	3,400	26,885	86.8
Tennessee	26	209	235	23,127	76.0	23	221	244	19,078	76.8
Utah	161	55	216	32,477	98.5	165	59	224	29,460	98.8
Virginia	127	234	361	49,083	91.6	123	245	368	42,764	93.0
Washington	62		62	11,315	47.9	58		58	9,894	47.6
West Virginia	1,104	2,245	3,349	43,393	95.7	1,187	2,270	3,457	38,184	95.8
Wyoming	37	292	329	26,197	96.1	15	312	327	26,700	97.1
Total	5,810	7,495	13,305	35,284	90.5	5,835	7,555	13,390	31,720	90.8

STRIPPING OPERATIONS

TABLE 28.—Stripping operations of all types in the bituminous-coal and lignite fields of the United States, by States and counties, in 1945 [1]

State and county	Number of strip pits	Number of power shovels and dragline excavators			Mined by stripping (net tons)	Average number of employees			Average number of days mines were active	Number of man-days worked	Average tons per man per day
		Steam	Electric	All others		In strip pits	All others	Total			
Alabama:											
Bibb and Marion	4			7	69,690	62	6	68	126	8,569	8.13
Blount	3	6		1	57,282	53	13	66	208	13,740	4.17
Jefferson	11	1		19	430,945	176	53	229	213	48,673	8.85
St. Clair	3			5	109,953	78	10	88	197	17,360	6.33
Tuscaloosa	4			6	157,850	61	16	77	235	18,075	8.73
Walker	27	2	2	38	1,042,689	472	144	616	193	118,939	8.77
Winston	1			3	22,410	16	4	20	140	2,800	8.00
Total Alabama	53	9	2	79	1,890,819	918	246	1,164	196	228,156	8.29
Arkansas:											
Franklin, Pope, and Scott	6	3		8	193,024	126	51	177	152	26,876	7.18
Johnson	5			7	184,712	91	15	106	189	19,993	9.24
Sebastian	12			19	294,088	200	56	256	130	33,396	8.81
Total Arkansas	23	3		34	671,824	417	122	539	149	80,265	8.37
Colorado:											
Jackson	2			1	10,896	8	1	9	182	1,639	6.65
Routt	3			4	41,915	30	15	45	120	5,390	7.78
Total Colorado	5			5	52,811	38	16	54	130	7,029	7.51
Georgia: Walker	1			1	10,221	10		10	175	1,750	5.84
Illinois:											
Bureau	1		2		83,248	14	18	32	225	7,211	11.54
Fulton	10		23	12	6,747,746	525	624	1,149	255	292,784	23.05
Gallatin	1	1			22,845	10	6	16	124	1,984	11.51
Grundy, La Salle, and Schuyler	6		18	4	1,723,119	300	231	531	292	154,856	11.13
Henry	1		2	1	422,457	50	73	123	272	33,456	12.63
Jackson	1		4		515,287	48	50	98	278	27,260	18.90
Knox	1		3	1	500,878	30	64	94	360	33,840	14.80
Livingston	1			1	7,659	8		8	227	1,816	4.22
Perry	3		13	3	2,832,178	288	315	603	249	150,078	18.87
Randolph	1		1	1	1,150,907	57	54	111	301	33,111	34.45

See footnote at end of table.

TABLE 28.—Stripping operations of all types in the bituminous-coal and lignite fields of the United States, by States and counties, in 1945 [1]—Continued

State and county	Number of strip pits	Number of power shovels and dragline excavators			Mined by stripping (net tons)	Average number of employees			Average number of days mines were active	Number of man-days worked	Average tons per man per day
		Steam	Electric	All others		In strip pits	All others	Total			
Illinois—Continued											
St. Clair	3		5	6	941,553	92	80	172	285	49,073	19.19
Saline	3		2	9	651,515	113	105	218	239	52,061	12.51
Vermilion	3			3	82,942	21	4	25	162	4,060	20.43
Will	2		2	1	456,240	70	60	130	281	36,498	12.50
Williamson	6		4	7	770,526	117	79	196	178	34,851	22.11
Total Illinois	43	1	79	49	16,909,100	1,743	1,763	3,506	260	913,239	18.52
Indiana:											
Clay	17	1	10	28	1,834,687	362	226	588	236	138,582	13.24
Daviess and Fountain	3			4	98,563	19	17	36	277	9,962	9.89
Greene	5	4	2	1	501,654	152	74	226	129	29,072	17.26
Knox	1		2	2	886,008	47	84	131	275	36,039	24.58
Owen	1			1	1,962	5		5	64	320	6.13
Pike	10	1	14	13	4,036,673	422	464	886	249	220,371	18.32
Spencer	4			7	174,586	56	20	76	190	14,446	12.09
Sullivan	5		10	2	1,709,740	248	222	470	352	165,427	10.34
Vermillion	3		2	4	307,007	57	63	120	164	19,629	15.64
Vigo	7		2	14	1,030,759	120	82	202	249	50,373	20.46
Warrick	5		9	7	2,882,450	342	228	570	287	163,363	17.64
Total Indiana	61	6	51	83	13,464,089	1,830	1,480	3,310	256	847,584	15.89
Iowa:											
Davis	1			1	6,192	6	6	12	57	680	9.11
Mahaska	8	2	1	12	177,859	77	40	117	255	29,824	5.96
Marion	7			16	251,865	61	45	106	204	21,632	11.64
Monroe and Van Buren	3			3	16,961	17	4	21	225	4,735	3.58
Wapello	4			9	68,181	41	6	47	129	6,041	11.29
Total Iowa	23	2	1	41	521,058	202	101	303	208	62,912	8.28
Kansas:											
Bourbon	4	1	2	1	172,850	46	19	65	217	14,129	12.23
Cherokee	11	4	7	5	1,256,403	246	147	393	246	96,496	13.02
Crawford	10	8	12	4	1,516,896	315	132	447	255	113,921	13.32
Labette and Osage	4	2		3	9,351	17	1	18	145	2,608	3.59
Total Kansas	29	15	21	13	2,955,500	624	299	923	246	227,154	13.01

Kentucky:											
Boyd	1			2	2,132	17	3	20	31	620	3.44
Butler	1			2	60,000	14	6	20	208	4,160	14.42
Christian	1			2	1,193	12	8	20	26	516	2.31
Clay	2			2	26,341	36	8	44	119	5,246	5.02
Daviess	2			3	137,000	32	3	35	160	5,598	24.47
Elliott, Ohio, and Rockcastle	4	1		6	174,693	43	34	77	220	16,976	10.29
Hopkins	18	1	8	30	4,537,871	420	296	716	274	196,373	23.11
Laurel	4	1		5	202,386	90	20	110	194	21,380	9.47
Muhlenberg	6		1	16	670,842	142	76	218	198	43,143	15.55
Perry	1			4	183,473	53	8	61	199	12,139	15.11
Pike	1			8	313,661	47	35	82	181	14,840	21.14
Pulaski	3			4	67,500	27	8	35	277	9,685	6.97
Webster	3			6	235,747	44	16	60	214	12,828	18.38
Whitley	1		1	2	82,000	18	22	40	222	8,880	9.23
Total Kentucky	48	3	10	92	6,694,839	995	543	1,538	229	352,384	19.00
Maryland:											
Allegany	7		1	9	207,527	109	27	136	170	23,103	8.98
Garrett	3			2	9,999	32	8	40	63	2,520	3.97
Total Maryland	10		1	11	217,526	141	35	176	146	25,623	8.49
Missouri:											
Barton	5	2	3	2	222,755	57	27	84	197	16,518	13.49
Bates	3	2	4	2	993,565	116	100	216	233	50,429	19.70
Boone	1			2	51,410	11	2	13	272	3,534	14.55
Callaway	3	1	2	5	189,406	65	30	95	307	29,130	6.50
Dade	3			4	7,480	9		9	235	2,118	3.53
Henry	7		7	3	643,295	97	43	140	246	34,392	18.70
Jasper	1	1			4,505	6		6	218	1,308	3.44
Johnson, Moniteau, and Randolph	3		2	2	464,643	62	42	104	226	23,462	19.80
Macon	1		2		476,635	88	66	154	244	37,604	12.68
Monroe	1			1	6,484	9		9	308	2,772	2.34
Vernon	8	4	3	5	432,124	119	25	144	248	35,683	12.11
Total Missouri	36	10	23	26	3,492,302	639	335	974	243	236,950	14.74
Montana:											
McCone (lignite)	1			1	1,133	2		2	135	270	4.20
Rosebud (bituminous)	1		7	1	2,555,208	86	20	106	303	32,122	79.55
Total Montana	2		7	2	2,556,341	88	20	108	300	32,392	78.92
New Mexico: McKinley	1			1	1,480	8	3	11	60	660	2.24
North Dakota (lignite)	30	3	14	26	1,859,674	282	161	443	220	97,573	19.06
Ohio:											
Athens	5		2	7	295,981	66	53	119	176	20,929	14.14
Belmont	15		2	35	1,194,966	305	85	390	168	65,421	18.27
Carroll	3	2		9	192,941	55	20	75	257	19,246	10.02
Columbiana	16			29	663,494	144	60	204	235	47,843	13.87

See footnote at end of table.

TABLE 28.—Stripping operations of all types in the bituminous-coal and lignite fields of the United States, by States and counties, in 1945 [1]—Continued

State and county	Number of strip pits	Number of power shovels and dragline excavators			Mined by stripping (net tons)	Average number of employees			Average number of days mines were active	Number of man-days worked	Average tons per man per day
		Steam	Electric	All others		In strip pits	All others	Total			
Ohio—Continued											
Coshocton	3	2		2	53,028	34	15	49	95	4,637	11.44
Guernsey, Holmes, Meigs, Morgan, Portage, and Wayne	8			15	289,307	99	48	147	151	22,180	13.04
Harrison	11		11	27	4,428,403	647	286	933	258	240,599	18.41
Hocking	5		1	11	258,516	74	49	123	166	20,475	12.63
Jackson	5			5	33,785	17	6	23	171	3,925	8.61
Jefferson	26	7	5	43	2,927,715	477	261	738	224	165,457	17.69
Mahoning	6	2		6	173,122	63	13	76	177	13,420	12.90
Muskingum	4	1		8	525,334	60	20	80	278	22,245	23.62
Noble	4			8	221,942	52	20	72	143	10,298	21.55
Perry	30	4	3	51	976,797	357	99	456	161	73,571	13.28
Stark	5	1		12	218,824	63	24	87	259	22,551	9.70
Tuscarawas	17	2	2	30	932,931	199	73	272	262	71,386	13.07
Vinton	9			11	96,703	65	11	76	187	14,230	6.80
Total Ohio	172	21	26	309	13,483,789	2,777	1,143	3,920	214	838,413	16.08
Oklahoma:											
Coal	3		3	5	296,337	69	36	105	220	23,069	12.85
Craig	1			1	8,216	8		8	234	1,872	4.39
Haskell	3	1		3	59,203	36	4	40	223	8,915	6.64
Latimer, Okmulgee, and Pittsburg	3			7	78,741	50	26	76	88	6,654	11.83
Muskogee	2	2			138,345	51	15	66	266	17,530	7.89
Rogers	3	5	3		453,855	91	59	150	262	39,226	11.57
Wagoner	3		3	2	593,721	81	53	134	246	32,900	18.05
Total Oklahoma	18	8	9	18	1,628,418	386	193	579	225	130,166	12.51
Pennsylvania:											
Allegheny	68	1		117	4,040,023	860	312	1,172	202	237,031	17.04
Armstrong	22	2		40	1,304,418	385	103	488	179	87,389	14.93
Beaver	7			10	174,702	67	22	89	234	20,789	8.40
Bedford	5	1		11	217,985	94	38	132	129	17,074	12.77
Blair	1			1	23,977	6	3	9	265	2,385	10.05
Butler	24	6		32	647,616	249	58	307	183	56,099	11.54
Cambria	29	1		40	823,519	321	99	420	133	55,848	14.75
Centre	17	5		28	616,831	266	69	335	207	69,227	8.91
Clarion	26			55	1,998,865	527	166	693	242	167,518	11.93
Clearfield	105	8		130	3,291,462	1,410	426	1,836	157	287,553	11.45

Clinton, Elk, McKean, and Venango	7	1		10	110,557	49	18	67	156	10,443	10.59
Fayette	43	5		44	1,246,843	351	90	441	167	73,617	16.94
Greene	11			12	326,486	109	30	139	187	26,055	12.53
Huntingdon	7			18	366,978	199	29	228	172	39,155	9.37
Indiana	45	3	2	74	2,270,731	692	207	899	188	169,114	13.43
Jefferson	23	1		25	619,133	241	70	311	150	46,641	13.27
Lawrence	5			7	115,572	25	10	35	214	7,482	15.45
Lycoming	1			1	12,465	8	2	10	172	1,720	7.25
Mercer	7			11	465,356	89	27	116	256	29,639	15.70
Somerset	36	1		50	1,455,036	383	139	522	207	107,896	13.49
Tioga	4	2		3	47,596	34	8	42	138	5,788	8.22
Washington	36	5	3	77	5,042,948	846	355	1,201	243	291,522	17.30
Westmoreland	69	3	3	76	2,488,571	736	140	876	177	155,232	16.03
Total Pennsylvania	598	45	8	872	27,707,670	7,947	2,421	10,368	190	1,965,217	14.10
South Dakota (lignite)	2			2	21,412	11		11	295	3,241	6.61
Tennessee:											
Anderson	3			3	12,680	19	2	21	123	2,582	4.91
Campbell	2			3	59,221	29	17	46	142	6,516	9.09
Hamilton and Scott	3			6	134,562	62	9	71	173	12,294	10.95
Total Tennessee	8			12	206,463	110	28	138	155	21,392	9.65
Texas (lignite)	1	2			79,949	19	7	26	158	4,096	19.52
Virginia:											
Buchanan	1			2	153,830	28	9	37	228	8,430	18.25
Wise	7			9	155,060	70	18	88	152	13,398	11.57
Total Virginia	8			11	308,890	98	27	125	175	21,828	14.15
Washington:											
King	4			4	63,398	65	15	80	104	8,313	7.63
Kittitas	2		2	2	88,413	35	14	49	252	12,334	7.17
Total Washington	6		2	6	151,811	100	29	129	160	20,647	7.35
West Virginia:											
Barbour	15			26	1,043,884	290	89	379	211	79,875	13.07
Boone, Gilmer, and Tucker	5			8	265,090	96	24	120	197	23,670	11.20
Brooke	9	1		17	747,761	177	37	214	209	44,779	16.70
Clay	1			1	1,253	4	2	6	19	114	10.99
Fayette	15	2		25	1,012,740	371	89	460	160	73,523	13.77
Greenbrier	10	2		20	357,054	165	38	203	199	40,423	8.83
Hancock	3	2		5	68,721	36	10	46	149	6,865	10.01
Harrison	66			136	7,098,740	1,515	564	2,079	207	431,158	16.46
Marion	12			12	680,678	196	79	275	141	38,641	17.62
Marshall	1	2			133,336	11	4	15	204	3,060	43.57
McDowell	1			2	115,854	23	7	30	228	6,852	16.91
Mineral	3			6	301,086	59	21	80	150	12,022	16.73
Mingo	1			3	160,269	26	15	41	279	11,439	14.01
Monongalia	9			20	619,679	159	48	207	177	36,696	16.89
Nicholas	2			6	159,632	54	19	73	159	11,596	13.72

See footnote at end of table.

TABLE 28.—Stripping operations of all types in the bituminous-coal and lignite fields of the United States, by States and counties, in 1945 [1]—Continued

State and county	Number of strip pits	Number of power shovels and dragline excavators			Mined by stripping (net tons)	Average number of employees			Average number of days mines were active	Number of man-days worked	Average tons per man per day
		Steam	Electric	All others		In strip pits	All others	Total			
West Virginia—Continued											
Preston	5	2		10	314,330	135	81	216	171	36,895	8.52
Raleigh	8	1		12	373,183	163	50	213	121	25,745	14.50
Randolph	6			14	454,583	117	38	155	198	30,687	14.81
Taylor	10			13	402,027	130	34	164	134	21,960	18.31
Upshur	4			4	36,855	22	9	31	78	2,429	15.17
Total West Virginia	186	12		340	14,246,255	3,749	1,258	5,007	187	938,429	15.18
Wyoming:											
Campbell and Sheridan	3		2	4	409,916	59	50	109	249	27,167	15.09
Carbon	3	1		5	444,708	70	28	98	286	28,026	15.87
Total Wyoming	6	1	2	9	854,624	129	78	207	267	55,193	15.48
Total United States	1,370	141	256	2,042	109,986,865	23,261	10,308	33,569	212	7,112,293	15.46

[1] On returns from mines combining stripping and underground methods in same operation, tonnage has been separated and figures on employment prorated so that this table includes only data pertaining to strip mining.

TABLE 29.—Summary of operations of power strip pits proper in the bituminous-coal and lignite fields of the United States, by States, in 1945

State	Number of strip pits	Number of power shovels and dragline excavators			Mined by stripping (net tons)	Average value per ton [1]	Number of men employed	Average number of days mines were active	Average tons per man per day
		Steam	Electric	All others					
Power strip pits proper:									
Alabama	45	9	2	79	1,830,039	$4.13	1,110	195	8.46
Arkansas	19	3	------	34	660,293	4.46	506	150	8.69
Colorado	4	------	------	5	50,568	3.52	50	133	7.63
Georgia	1	------	------	1	10,221	3.85	10	175	5.84
Illinois	42	1	79	49	16,907,529	2.28	3,503	261	18.52
Indiana	53	6	51	83	13,449,038	2.25	3,284	257	15.93
Iowa	22	2	1	41	517,990	3.10	298	208	8.37
Kansas	22	15	21	13	2,928,962	2.45	894	248	13.22
Kentucky	46	3	10	92	6,685,657	2.34	1,523	230	19.05
Maryland	6	------	1	11	204,975	3.19	147	151	9.22
Missouri	33	10	23	26	3,486,501	2.45	965	245	14.78
Montana (bituminous)	1	------	7	1	2,555,208	1.17	106	303	79.55
Montana (lignite)	1	------	------	1	1,133	2.65	2	135	4.20
New Mexico	1	------	------	1	1,480	3.55	11	60	2.24
North Dakota (lignite)	24	3	14	26	1,840,209	1.52	407	226	19.97
Ohio	172	21	26	309	13,483,789	2.59	3,920	214	16.08
Oklahoma	16	8	9	18	1,624,772	3.08	567	227	12.60
Pennsylvania	542	45	8	872	27,426,421	3.08	9,910	195	14.22
South Dakota (lignite)	1	------	------	2	4,320	2.55	3	275	5.24
Tennessee	7	------	------	12	201,171	3.28	134	151	9.97
Texas (lignite)	1	2	------	------	79,949	.85	26	158	19.52
Virginia	8	------	------	11	308,890	2.95	125	175	14.15
Washington	5	------	2	6	148,658	4.98	124	162	7.41
West Virginia	175	12	------	340	14,187,063	2.93	4,918	190	15.21
Wyoming	6	1	2	9	854,624	2.44	207	267	15.48
Total from power strip pits proper	1,253	141	256	2,042	109,449,460	2.64	32,750	215	15.57
Horse stripping operations	117	------	------	------	537,405	3.18	819	104	6.32
Grand total	1,370	141	256	2,042	109,986,865	2.65	33,569	212	15.46

[1] Value received or charged for coal, f. o. b. mine, including selling cost.

POWER DRILLING

TABLE 30.—Summary of operations of underground bituminous-coal and lignite mines where shot holes were power-drilled in the United States, by States, in 1945

State	Number of mines using power drills		Number of power drills								Net tons produced in working places where shot holes were power-drilled			Total production from mines using power drills (net tons)		
			Electric				Compressed air									
	In coal and coal and rock	In rock only	In coal only	In coal and rock	In rock only	Total	In coal only	In coal and rock	In rock only	Total	Electric drills	Compressed air drills	Total	In coal and coal and rock	In rock only	Total
Alabama	55	4	717	150	19	886	9	------	154	163	11, 632, 665	95, 000	11, 727, 665	13, 140, 230	663, 187	13, 803, 417
Alaska	3	------	12	------	------	12	30	------	6	36	108, 478	158, 219	266, 697	266, 697	----------	266, 697
Arkansas	5	16	16	3	5	24	------	------	43	43	264, 550	----------	264, 550	285, 344	724, 912	1, 010, 256
Colorado	63	5	288	101	4	393	1	------	57	58	4, 866, 092	20, 000	4, 886, 092	6, 111, 75o	649, 478	6, 761, 234
Illinois	131	------	978	125	6	1, 109	------	------	34	34	51, 980, 111	----------	51, 980, 111	52, 641, 389	----------	52, 641, 389
Indiana	30	1	161	108	6	275	------	------	2	2	10, 912, 582	----------	10, 912, 582	10, 960, 918	79, 895	11, 040, 813
Iowa	10	------	30	6	------	36	------	------	------	------	449, 681	----------	449, 681	487, 379	----------	487, 379
Kentucky	245	19	1, 066	157	46	1, 269	43	3	145	191	39, 599, 620	860, 633	40, 460, 253	45, 150, 384	3, 194, 372	48, 344, 756
Maryland	3	3	24	------	3	27	------	------	7	7	252, 681	----------	252, 681	506, 520	80, 985	587, 505
Michigan	3	------	7	1	------	8	------	------	1	1	86, 332	----------	86, 332	125, 704	----------	125, 704
Missouri	5	2	6	1	------	7	------	------	2	2	152, 572	----------	152, 572	152, 572	59, 293	211, 865
Montana: Bituminous	9	------	43	2	1	46	------	------	3	3	1, 802, 921	----------	1, 802, 921	1, 802, 921	----------	1, 802, 921
Lignite	6	------	12	------	------	12	------	------	------	------	33, 404	----------	33, 404	33, 404	----------	33, 404
New Mexico	4	------	32	------	------	32	------	------	6	6	1, 020, 092	----------	1, 020, 092	1, 095, 434	----------	1, 095, 434
North-South Dakota (lignite)	10	------	16	------	------	16	1	------	------	1	568, 850	5, 940	574, 790	574, 790	----------	574, 790
Ohio	42	5	296	93	27	416	------	------	4	4	13, 376, 307	----------	13, 376, 307	14, 217, 939	388, 895	14, 606, 834
Oklahoma	8	4	48	21	9	78	------	------	------	------	736, 754	----------	736, 754	763, 805	125, 292	889, 097
Oregon	1	------	------	------	------	------	3	2	------	5	----------	16, 500	16, 500	16, 500	----------	16, 500
Pennsylvania	203	51	1, 344	445	130	1, 919	52	3	544	599	53, 360, 238	1, 706, 460	55, 066, 698	70, 642, 790	9, 989, 454	80, 632, 244
Tennessee	31	5	161	6	7	174	7	1	36	44	3, 315, 803	136, 104	3, 451, 907	3, 775, 942	468, 013	4, 243, 955
Utah	27	------	261	4	2	267	------	------	28	28	6, 457, 004	----------	6, 457, 004	6, 560, 732	----------	6, 560, 732
Virginia	41	6	219	------	6	225	------	------	68	68	7, 606, 792	----------	7, 606, 792	10, 897, 386	1, 049, 487	11, 946, 873
Washington	16	------	61	14	------	75	133	6	34	173	280, 803	704, 617	985, 420	1, 072, 563	----------	1, 072, 563
West Virginia	350	57	2, 076	337	90	2, 503	2	7	367	376	81, 112, 970	165, 150	81, 278, 120	101, 131, 233	15, 406, 472	116, 537, 705
Wyoming	25	------	451	5	2	458	4	------	7	11	8, 889, 362	50, 702	8, 940, 064	8, 940, 064	----------	8, 940, 064
Total	1, 326	178	8, 325	1, 579	363	10, 267	285	22	1, 548	1, 855	298, 866, 664	3, 919, 325	302, 785, 989	351, 354, 396	32, 879, 735	384, 234, 131

MECHANICAL LOADING

The quantity of bituminous coal and lignite mechanically loaded in underground mines increased from about 2 million tons, or 0.3 percent of the total underground output, in 1923 to more than 262 million tons, or 56 percent, in 1945. (See table 16.)

Mechanical loading equipment used in underground bituminous-coal and lignite mines is divided into two types: Devices that practically eliminate hand shoveling (known as mobile loaders, scrapers, and self-loading conveyors or duckbills) and those that greatly reduce the labor in hand shoveling (known as hand-loaded face conveyors and pit-car loaders). Devices in the first category are designated as "machines" and those in the second category as "conveyors."

Sales of Mechanical Loading Equipment in 1946.—The estimated capacity of mechanical loading equipment sold for underground use in all coal mines was 20 percent more in 1946 than in 1945. Table 31 shows the sales reported, by type of equipment, and the number of manufacturers reporting for 1939–46.

Sales of conveyors to bituminous-coal and lignite mines in 1946 totaled 838 units. The figures for 1942–46 exclude duckbills, which were included in all previous years. Therefore, these sales are not comparable with those for 1941 or earlier years.

The number of mobile loaders, scrapers, and conveyors shipped into the various States and groups of States in 1946 and the number of units in actual use in 1945 are shown in table 33.

Statistics on Mechanical Loading in Bituminous-Coal and Lignite Mines in 1945.—During 1945 the approximate percentage of the tonnage loaded by each type of equipment was as follows: Mobile loaders, 76; hand-loaded conveyors, 15; duckbills, 8; and pit-car loaders and scrapers combined, 1.

Mobile loaders handle more coal than all other types of mechanical loading devices combined. Where coal is loaded by mobile loaders it is more commonly loaded directly into mine cars, but some tonnage is loaded into shuttle cars or onto conveyors. During 1945, 73 percent of the bituminous coal and lignite handled by mobile loaders was loaded directly into mine cars, 23 percent into shuttle cars, and 4 percent onto conveyors.

During 1945, in underground bituminous-coal and lignite mines 2,950 mobile loaders handled 198,668,462 net tons, an average of 67,345 tons per mobile loader per year; scrapers averaged 14,389; pit-car loaders, 6,942; duckbills, 15,550; and hand-loaded face conveyors, 11,847, per year per unit for the same period. (See tables 32 and 34.)

Mechanical Loading by States.—West Virginia has been the leading producer of mechanically loaded coal since 1939. During 1945, West Virginia produced 78,358,267 tons of mechanically loaded coal, followed by Illinois with 48,997,059, Pennsylvania with 44,554,921, Kentucky with 24,773,383, and Ohio with 12,937,079 tons. These five States produced 80 percent of the total output of underground mechanically loaded bituminous coal in the United States in 1945.

Detailed data, by States, on the number of mines and machines and the production of mechanically loaded coal compared with the total production at mines using mechanical loading devices are given in table 35. Comparative changes in underground mechanical loading in 1944–45, by States, are shown in table 36.

Table 37 shows bituminous-coal and lignite tonnage mined by stripping compared with underground hand-loaded and machine-loaded tonnage, by States, for 1945.

TABLE 31.—Units of mechanical loading equipment sold to bituminous-coal and lignite mines for underground use in the United States, as reported by manufacturers, 1939–46

	1939	1940	1941	1942	1943	1944	1945	1946	Change, 1946 from 1945 (percent)
Type of equipment:									
Mobile loaders	292	233	367	352	234	282	349	490	+40.4
Scrapers [1]	18	36	8	15	13	20	6	3	−50.0
Conveyors [2]	1,095	1,573	1,800	1,167	798	580	738	838	+13.6
Pit-car loaders	2	3	10	2	1	------	(3)	(3)	----------
Total, all types	1,407	1,845	2,185	1,536	1,046	882	1,093	1,331	+21.8
Number of manufacturers reporting	31	32	32	28	24	22	25	24	----------

[1] Reported as scrapers or scraper haulers and hoists.
[2] Includes hand-loaded conveyors and those equipped with duckbills or other self-loading heads. Sales of both loading heads and shaker conveyors were counted for years 1939–41, inclusive; but figures for 1942–46, inclusive, do not include loading heads separately.
[3] Discontinued canvass of sales of pit-car loaders in 1945.

TABLE 32.—Units of mechanical loading equipment in use in underground bituminous-coal and lignite mines in the United States, 1940–45

Type of equipment	1940	1941	1942	1943	1944	1945	Change, 1945 from 1944 (percent)
Mobile loaders	1,720	1,985	2,301	2,525	2,737	2,950	+7.8
Scrapers	116	109	93	83	87	87	----------
Pit-car loaders	697	607	481	321	241	142	−41.1
Conveyors equipped with duckbills or other self-loading heads	656	788	1,062	1,226	1,331	1,383	+3.9
Hand-loaded conveyors	2,263	2,807	3,041	3,191	3,236	3,385	+4.6
Total, all types	5,452	6,296	6,978	7,346	7,632	7,947	+4.1

TABLE 33.—Comparison of mechanical loading equipment and "mother" conveyors in actual use in bituminous-coal and lignite mines in the United States in 1945 with sales reported in 1946, by States and regions

State and region	Mechanical loading equipment						"Mother" conveyors [2]	
	Mobile loaders		Scrapers		Conveyors [1]			
	In use in 1945	Sales in 1946	In use in 1945	Sales in 1946	In use in 1945	Sales in 1946	In use in 1945	Sales in 1946
Northern Appalachian States:								
Maryland					31	5		
Michigan					5	3	1	2
Ohio	174	22			155	35	23	10
Pennsylvania	651	90	13		822	123	92	29
Southern Appalachian States:								
Alabama	103	26	49	1	396	43	63	7
Kentucky	237	55	1		594	101	107	20
Tennessee	11	5			168	20	32	2
Virginia	78	11			127	24	8	10
West Virginia	764	216	2	1	1,395	377	270	51
East Central States:								
Illinois	570	23			26	9	27	14
Indiana	160	13				6	2	1
States west of Mississippi River [3]	202	29	22	1	1,049	92	84	37
Total	2,950	490	87	3	4,768	838	709	183

[1] Includes hand-loaded conveyors and conveyors equipped with duckbills or other self-loading heads.
[2] Includes all haulage conveyors with capacities over 500 feet, except main-slope conveyors.
[3] Includes Arkansas, Colorado, Iowa, Kansas, Montana, New Mexico, North Dakota, Oklahoma, Oregon, Utah, Washington, and Wyoming.

TABLE 34.—Bituminous coal and lignite mechanically loaded underground in the United States, by types of loading equipment, 1944–45

Type of equipment	1944		1945	
	Net tons	Percent of total	Net tons	Percent of total
Mobile loaders	202,875,221	74.0	198,668,462	75.7
Scrapers	1,341,450	.5	1,251,868	.5
Pit-car loaders	1,835,178	.7	985,817	.4
Conveyors equipped with duckbills or other self-loading heads	23,163,541	8.4	21,505,950	8.2
Hand-loaded conveyors	44,973,742	16.4	40,100,632	15.2
Grand total loaded mechanically	274,189,132	100.0	262,512,729	100.0

TABLE 35.—Mechanical loading underground in bituminous-coal and lignite mines in the United States, by States, in 1945

State	Number of mines				Number of loading devices					Production mechanically loaded (net tons)			Total underground production at mines using mechanical loading devices (net tons)			
	Using loading machines only [1]	Using conveyors only [2]	Using both loading machines and conveyors	Total	Mobile loading machines	Scrapers	Conveyors equipped with duckbills or other self-loading heads	Pit-car loaders	Hand-loaded conveyors [3]	Loaded by machines [1]	Handled by conveyors [2]	Total	Mines using loading machines only [1]	Mines using conveyors only [2]	Mines using both loading machines and conveyors	Total
Alabama	18	19	11	48	103	49	46	2	350	5,270,582	4,053,933	9,324,515	4,423,206	3,863,942	4,472,034	12,759,182
Arkansas		18		18					50		773,472	773,472		773,472		773,472
Colorado	33	19	9	61	34		184	1	113	3,488,332	809,687	4,298,019	4,144,044	828,492	846,876	5,819,412
Illinois	68	2	8	78	570		22	79	4	48,410,628	586,431	48,997,059	45,353,513	250,405	4,563,388	50,167,306
Indiana	20		2	22	160			12		10,541,050	36,177	10,577,227	10,331,836		245,391	10,577,227
Iowa	2			2	3		14			248,141		248,141	266,439			266,439
Kentucky	94	38	16	148	237	1	208		386	20,429,297	4,344,086	24,773,383	24,921,757	4,306,793	6,199,936	35,428,486
Maryland		4	1	5			3		28	33,567	176,024	209,591		406,316	148,824	555,140
Michigan		1		1					5		53,656	53,656		93,028		93,028
Montana (bituminous and lignite)	8	1	1	10	49		6	6	2	1,774,152	20,000	1,794,152	1,656,440	25,178	127,712	1,809,330
New Mexico	3		1	4	12	8			1	761,484	3,861	765,345	721,798		373,636	1,095,434
North Dakota (lignite)	3			3	7					543,351		543,351	585,860			585,860
Ohio	26	1	3	30	174		131		24	12,555,496	381,583	12,937,079	12,660,244	44,574	983,699	13,688,517
Oklahoma		10	1	11	4				131	125,000	723,908	848,908		719,697	162,539	882,236
Oregon		1		1					2		16,500	16,500		16,500		16,500
Pennsylvania	99	56	34	189	651	13	98	22	724	37,181,093	7,373,828	44,554,921	49,028,202	9,246,207	11,063,906	69,338,315
Tennessee	12	12	7	31	11		32		136	936,816	1,693,723	2,630,539	1,594,970	1,710,498	964,439	4,269,907
Utah	13	3	5	21	67		98		25	5,742,076	217,596	5,959,672	5,423,104	159,280	664,601	6,246,985
Virginia	19	9	9	37	78		16		111	4,104,531	1,198,432	5,302,963	5,328,416	1,135,444	3,610,413	10,074,273
Washington	3	5	4	12	1	4	8		92	103,393	599,237	702,630	93,252	220,559	510,983	824,794
West Virginia	155	125	81	361	764	2	245	19	1,150	60,838,348	17,519,919	78,358,267	61,290,035	21,578,344	24,757,028	107,625,407
Wyoming	16	4	3	23	25	10	272	1	51	8,338,943	504,396	8,843,339	7,830,677	200,329	831,635	8,862,641
Total: 1945	592	328	196	1,116	2,950	87	1,383	142	3,385	221,426,280	41,086,449	262,512,729	235,653,793	45,579,058	60,527,040	341,759,891
1944	538	332	187	1,057	2,737	87	1,331	241	3,236	227,380,212	46,808,920	274,189,132	247,419,187	51,204,585	67,272,185	365,895,957
Percent change, 1945 from 1944	+10.0	−1.2	+4.8	+5.6	+7.8		+3.9	−41.1	+4.6	−2.6	−12.2	−4.3	−4.8	−11.0	−10.0	−6.6

[1] Includes mobile loaders, scrapers, and conveyors equipped with duckbills or other self-loading heads. Some mines in this class also use conveyors or shuttle cars in conjunction with mobile loaders to perform initial phase of transportation.

[2] Includes hand-loaded conveyors and pit-car loaders.

[3] Number of units.

TABLE 36.—Comparative changes in underground mechanical loading of bituminous coal and lignite, by principal types of loading devices, in the United States, by States, 1944–45

State	Net tons						Handled by each class (percent)				Underground output mechanically loaded (percent)	
	1944			1945			1944		1945			
	Loaded by machines [1]	Handled by conveyors [2]	Total	Loaded by machines [1]	Handled by conveyors [2]	Total	Loaded by machines [1]	Handled by conveyors [2]	Loaded by machines [1]	Handled by conveyors [2]	1944	1945
Alabama	5,013,477	4,991,218	10,004,695	5,270,582	4,053,933	9,324,515	50.1	49.9	56.5	43.5	57.0	57.0
Arkansas		898,388	898,388		773,472	773,472		100.0		100.0	67.2	65.4
Colorado	3,363,697	747,482	4,111,179	3,488,332	809,687	4,298,019	81.8	18.2	81.2	18.8	50.4	56.8
Illinois	50,116,239	748,996	50,865,235	48,410,628	586,431	48,997,059	98.5	1.5	98.8	1.2	86.5	87.3
Indiana	12,349,719	151,604	12,501,323	10,541,050	36,177	10,577,227	98.8	1.2	99.7	.3	90.4	90.3
Iowa	[3] 274,593	[3]	274,593	248,141		248,141	[3] 100.0	[3]	100.0		16.9	16.3
Kentucky	19,759,017	3,669,612	23,428,629	20,429,297	4,344,086	24,773,383	84.3	15.7	82.5	17.5	35.5	39.4
Maryland	[4]	[4] 269,008	269,008	33,567	176,024	209,591	[4]	[4] 100.0	16.0	84.0	15.5	13.6
Michigan		61,922	61,922		53,656	53,656		100.0		100.0	44.2	42.7
Montana (bituminous and lignite)	2,147,114	30,000	2,177,114	1,774,152	20,000	1,794,152	98.6	1.4	98.9	1.1	93.3	93.9
New Mexico	778,795	3,867	782,662	761,484	3,861	765,345	99.5	.5	99.5	.5	44.9	51.6
North Dakota (lignite)	561,763		561,763	543,351		543,351	100.0		100.0		79.2	82.0
Ohio	14,493,503	630,874	15,124,377	12,555,496	381,583	12,937,079	95.8	4.2	97.1	2.9	68.1	67.2
Oklahoma	101,747	853,215	954,962	125,000	723,908	848,908	10.7	89.3	14.7	85.3	61.3	66.3
Oregon					16,500	16,500				100.0		100.0
Pennsylvania	38,553,892	9,981,482	48,535,374	37,181,093	7,373,828	44,554,921	79.4	20.6	83.5	16.5	39.3	42.3
Tennessee	651,107	1,845,951	2,497,058	936,816	1,693,723	2,630,539	26.1	73.9	35.6	64.4	34.9	43.4
Utah	6,178,827	265,732	6,444,559	5,742,076	217,596	5,959,672	95.9	4.1	96.3	3.7	90.5	89.2
Virginia	3,726,643	1,351,810	5,078,453	4,104,531	1,198,432	5,302,963	73.4	26.6	77.4	22.6	26.2	31.3
Washington	134,926	699,349	834,275	103,393	599,237	702,630	16.2	83.8	14.7	85.3	57.0	58.3
West Virginia	61,007,359	18,965,117	79,972,476	60,838,348	17,519,919	78,358,267	76.3	23.7	77.6	22.4	52.7	56.9
Wyoming	8,167,794	643,293	8,811,087	8,338,943	504,396	8,843,339	92.7	7.3	94.3	5.7	98.2	98.3
Total	227,380,212	46,808,920	274,189,132	221,426,280	41,086,449	262,512,729	82.9	17.1	84.3	15.7	52.9	56.1

[1] Includes mobile loaders, scrapers, and conveyors equipped with duckbills or other self-loading heads.
[2] Includes hand-loaded conveyors and pit-car loaders.
[3] "Loaded by machines" includes small amount "Handled by conveyors."
[4] "Handled by conveyors" includes small amount "Loaded by machines."

TABLE 37.—Bituminous coal and lignite in the United States mined underground and from strip pits and method of loading underground, in net tons, by States, in 1945

State	Mined by stripping	Mined underground			Grand total production
		Hand-loaded	Mechanically loaded	Total	
Alabama	1,890,819	7,021,205	9,324,515	16,345,720	18,236,539
Alaska		297,644		297,644	297,644
Arizona		3,853		3,853	3,853
Arkansas	671,824	408,630	773,472	1,182,102	1,853,926
Colorado	52,811	3,270,182	4,298,019	7,568,201	7,621,012
Georgia	10,221	32,347		32,347	42,568
Illinois	16,909,100	7,105,033	48,997,059	56,102,092	73,011,192
Indiana	13,464,089	1,141,295	10,577,227	11,718,522	25,182,611
Iowa	521,058	1,276,401	248,141	1,524,542	2,045,600
Kansas	2,955,500	273,059		273,059	3,228,559
Kentucky	6,694,839	38,124,714	24,773,383	62,898,097	69,592,936
Maryland	217,526	1,335,586	209,591	1,545,177	1,762,703
Michigan		72,048	53,656	125,704	125,704
Missouri	3,492,302	490,422		490,422	3,982,724
Montana (bituminous)	2,555,208	82,240	1,787,743	1,869,983	4,425,191
Montana (lignite)	1,133	34,055	6,409	40,464	41,597
New Mexico	1,480	716,861	765,345	1,482,206	1,483,686
North Dakota (lignite)	1,859,674	119,294	543,351	662,645	2,522,319
Ohio	13,483,789	6,316,567	12,937,079	19,253,646	32,737,435
Oklahoma	1,628,418	431,650	848,908	1,280,558	2,908,976
Oregon			16,500	16,500	16,500
Pennsylvania	27,707,670	60,702,752	44,554,921	105,257,673	132,965,343
South Dakota (lignite)	21,412	3,033		3,033	24,445
Tennessee	206,463	3,433,706	2,630,539	6,064,245	6,270,708
Texas (lignite)	79,949				79,949
Utah		719,391	5,959,672	6,679,063	6,679,063
Virginia	308,890	11,623,140	5,302,963	16,926,103	17,234,993
Washington	151,811	502,803	702,630	1,205,433	1,357,244
West Virginia	14,246,255	59,430,210	78,358,267	137,788,477	152,034,732
Wyoming	854,624	149,612	8,843,339	8,992,951	9,847,575
Total	109,986,865	205,117,733	262,512,729	467,630,462	577,617,327

MECHANICAL CLEANING

The percentage of the total production of bituminous coal that was mechanically cleaned increased from 5.3 in 1927, the first year complete data were collected, to 25.6 in 1944 and remained at 25.6 during 1945. (See table 14.)

In the following tables coal cleaned at consumer-operated plants was tabulated in State where the plant was located. All coal cleaned at plants other than consumer-operated plants was included in State from which the coal was mined.

Tables 38, 39, 42, and 43 include mechanical cleaning data on all coal mined in the United States except Pennsylvania anthracite. Tables 40 and 41 are on the same basis but do not include consumer-operated plants. There are no mechanical cleaning plants at lignite mines.

Consumer-operated plants include plants owned by steel companies which receive coal from various mines (but usually from affiliated companies), clean it, and then consume it directly at the plant.

Table 38 compares bituminous coal cleaned in 1942–45 by method of cleaning. Both wet and pneumatic methods decreased in 1945 from 1944.

Mechanical Cleaning by Types of Equipment.—The tonnage of bituminous coal cleaned by wet-washing methods was 130,469,739

net tons in 1945—a decrease of 6 percent from 1944. The quantity cleaned by pneumatic methods was 17,416,197 net tons—a decrease of 13 percent.

Table 39 compares the number of cleaning plants and the net tons of cleaned coal, by types of equipment, for 1944 and 1945. During 1945, 412 wet-washing and 83 pneumatic cleaning plants were in operation. Fifty-six tipples used both wet and dry methods at the same plant; deducting these duplications gives a net total of 439 plants that cleaned coal in 1945—the same number as in 1944.

Wet methods of cleaning coal include piston- or common-type jigs, Baum-type jigs, concentrating tables, launders and upward-current classifiers, and any combinations of these four methods. Baum-type jigs cleaned approximately 42 percent of the total coal cleaned by wet methods during 1945.

Pneumatic methods of coal cleaning include air tables, air flow, air sand, and any combinations of these three methods. During 1945, air tables cleaned approximately 59 percent of the total coal cleaned by pneumatic methods.

Mines served by cleaning plants, exclusive of those that ship to washeries operated by steel companies, produced a total of 214,258,070 tons, or 37 percent, of the total bituminous output in 1945. In this same group of mines, 138,834,782 tons were mechanically cleaned; therefore, 65 percent of the coal produced at mines with cleaning plants in 1945 was cleaned at the mine. The remainder of the output from these mines (35 percent) presumably represents the larger sizes commonly picked by hand.

Table 40 shows total production of coal at mines with cleaning plants by methods of preparation in 1944 and 1945.

Coal Cleaning by States.—The following States led in volume of of coal mechanically cleaned in the United States in 1945: Pennsylvania, 22.2 percent of total; West Virginia, 21.4; Illinois, 20.8; Alabama, 9.4; and Indiana, 7.5 percent. These five States accounted for 81.3 percent of the total mechanically cleaned coal in 1945. Table 42 shows the number of plants in operation, tons of clean coal, and percentage of State output mechanically cleaned in 1944 and 1945.

Relation Between Raw Coal, Clean Coal, and Refuse.—For every 100 tons of raw coal cleaned during 1945 at the mines, 85 tons of clean merchantable coal, on an average, were obtained, and 15 tons of refuse were discarded. Table 43 shows total production of mines with cleaning plants and results of cleaning operations, by States.

Methods of Mining at Mines Served by Cleaning Plants.—Mechanical loading, both in underground mines and strip pits, appears to be closely related to mechanical cleaning. Table 41 shows the mining methods at mines having cleaning plants. Production of coal from strip mines in 1945 was 109,986,865 tons (see table 37), of which 35,910,050 tons (33 percent) came from strip mines having mechanical cleaning tipples. Underground coal loaded mechanically in 1945 totaled 262,512,729 tons, of which 129,733,226 tons (49 percent) passed through tipples equipped with mechanical-cleaning devices. Hand-loaded underground coal production in 1945 totaled 205,117,733 tons, of which 24 percent passed through tipples equipped with cleaning plants.

TABLE 38.—Bituminous coal mechanically cleaned by wet and pneumatic methods, in the United States, in net tons of clean coal, 1942–45

Method of cleaning	1942	1943	1944	1945	Change 1945 from 1944 (percent)
By wet methods:					
At mines	111,210,109	114,467,591	128,390,547	121,418,585	−5.4
At consumer-operated cleaning plants	10,789,749	9,967,184	10,272,142	9,051,154	−11.9
Total wet methods	121,999,858	124,374,775	138,662,689	130,469,739	−5.9
By pneumatic methods	20,187,488	21,201,074	20,064,440	17,416,197	−13.2
Grand total	142,187,346	145,575,849	158,727,129	147,885,936	−6.8

TABLE 39.—Bituminous coal cleaned in the United States, by types of equipment in actual operation, 1944–45

[Coal cleaned and plants operated by consumers at central washeries in Colorado and Pennsylvania included]

Type of equipment	Plants in operation		Net tons of clean coal		Cleaned by each type (percent of total)	
	1944	1945	1944	1945	1944	1945
Wet methods:						
Jigs	216	219	74,174,424	68,608,875	46.7	46.4
Concentrating tables	11	13	2,752,612	2,594,085	1.8	1.8
Jigs in combination with concentrating tables	18	16	4,649,192	4,754,311	2.9	3.2
Jigs in combination with launders and upward-current classifiers	19	18	8,535,393	8,454,561	5.4	5.7
Launders and upward-current classifiers	146	146	48,551,068	46,057,907	30.6	31.1
Total wet methods	410	412	138,662,689	130,469,739	87.4	88.2
Pneumatic methods	82	83	20,064,440	17,416,197	12.6	11.8
Grand total	[1] 492	[1] 495	158,727,129	147,885,936	100.0	100.0

[1] Number of plants using both wet and pneumatic methods was 53 in 1944 and 56 in 1945.

TABLE 40.—Total production of all coal at bituminous mines in the United States, having cleaning plants, in net tons, 1944–45

[Does not include any estimate for mines that may ship to consumer-operated plants]

Type of equipment	1944	1945	Change 1945 from 1944 (percent)
Wet methods:			
Jigs	111,163,648	104,445,160	−6.1
Concentrating tables	2,026,953	2,018,364	−.4
Jigs in combination with concentrating tables	5,271,277	5,039,409	−4.4
Jigs in combination with launders and upward-current classifiers	13,026,722	12,394,420	−4.9
Launders and upward-current classifiers	87,864,211	79,567,648	−9.5
Total wet methods	219,352,811	203,465,001	−7.3
Pneumatic methods	54,578,526	47,386,413	−13.2
Grand total	273,931,337	250,851,414	−8.4
Less duplications [1]	40,995,557	36,593,344	−10.7
Net total	232,935,780	214,258,070	−8.0
United States, total production [2]	619,576,240	577,617,327	−6.8
Percent produced at mines having cleaning plants	37.6	37.1	

[1] Mines using both wet and pneumatic methods.

[2] For purposes of historical comparison and statistical convenience, figures include output of lignite and of anthracite and semianthracite outside of Pennsylvania. There are no mechanical cleaning plants at lignite mines.

TABLE 41.—Method of mining at bituminous-coal mines in the United States served by cleaning plants, 1942–45

[Does not include any estimate for mines that may ship to consumer-operated plants]

Method of mining in use	Total net tons produced from mines that move coal to cleaning plants				Change 1945 from 1944 (percent)
	1942	1943	1944	1945	
Mined from strip pits	28, 597, 289	30, 326, 426	32, 444, 227	35, 910, 050	+10. 7
Mechanically loaded underground	118, 917, 178	125, 313, 683	137, 926, 900	129, 733, 226	−5. 9
Hand-loaded underground	70, 559, 424	67, 258, 305	62, 564, 653	48, 614, 794	−22. 3
Total	218, 073, 891	222, 898, 414	232, 935, 780	214, 258, 070	−8. 0

TABLE 42.—Bituminous coal mechanically cleaned by wet and pneumatic methods in the United States, by States, 1944–45

[Coal cleaned and plants operated by consumers at central washeries in Colorado and Pennsylvania included]

State	Plants in operation		Net tons of clean coal		Output mechanically cleaned (percent)	
	1944	1945	1944	1945	1944	1945
Alabama	55	53	14, 453, 892	13, 831, 185	77. 1	75. 8
Alaska	2	2	188, 558	158, 800	54. 1	53. 4
Arkansas	2	3	41, 877	71, 951	2. 1	3. 9
Colorado	8	7	1, 131, 259	1, 135, 679	13. 9	15. 0
Illinois	54	55	32, 965, 139	30, 710, 862	42. 9	42. 1
Indiana	20	20	11, 667, 478	11, 135, 525	41. 7	44. 2
Kansas	5	5	1, 672, 834	1, 588, 125	49. 7	49. 2
Kentucky	20	20	8, 374, 636	8, 043, 420	11. 7	11. 6
Michigan	1	1	17, 880	11, 949	12. 8	9. 5
Missouri	11	11	3, 525, 474	2, 960, 031	73. 8	74. 3
Montana	2	2	211, 692	302, 978	4. 4	6. 8
New Mexico	2	3	95, 856	303, 470	5. 5	20. 5
Ohio	10	10	6, 362, 939	6, 292, 400	18. 8	19. 2
Oklahoma	2	3	244, 010	239, 169	7. 6	8. 2
Oregon	------	1	------	13, 072	------	79. 2
Pennsylvania [1]	63	65	37, 349, 752	32, 880. 671	25. 6	24. 7
Tennessee	4	3	350, 229	114, 695	4. 8	1. 8
Utah	3	3	2, 064, 798	1, 682, 138	29. 0	25. 2
Virginia	20	20	3, 670, 435	3, 623, 548	18. 8	21. 0
Washington	22	20	1, 254, 605	1, 114, 360	82. 3	82. 1
West Virginia [2]	133	132	33, 083, 786	31, 671, 908	20. 1	20. 8
Total	[3] 439	[4] 439	158, 727, 129	147, 885, 936	25. 6	25. 6

[1] Includes some coal mined in Pennsylvania and cleaned in Ohio and a small tonnage mined in other States and cleaned at a consumer-operated plant in Pennsylvania.
[2] Includes some coal mined in West Virginia and cleaned in Ohio and Pennsylvania.
[3] Represents 53 plants using both wet and pneumatic methods of cleaning and 386 plants using only 1 cleaning method.
[4] Represents 56 plants using both wet and penumatic methods of cleaning and 383 plants using only 1 cleaning method.

TABLE 43.—Result of operations at bituminous-coal-cleaning plants in the United States, by States, in net tons, in 1945

State	Total raw coal moved to cleaning plants	Coal obtained in cleaning process	Refuse resulting in cleaning process	Ratio of refuse to raw coal (percent)[1]	Total production from mines that moved coal to cleaning plants
Alabama	17,491,649	13,831,185	3,660,464	20.9	14,661,420
Alaska	237,902	158,800	79,102	33.2	158,800
Arkansas	89,047	71,951	17,096	19.2	370,956
Colorado	158,271	149,126	9,145	5.8	645,293
Illinois	36,665,264	30,710,862	5,954,402	16.2	48,386,787
Indiana	13,084,269	11,135,525	1,948,744	14.9	14,861,531
Kansas	2,012,288	1,588,125	424,163	21.1	1,588,125
Kentucky	9,977,020	8,043,420	1,933,600	19.4	12,017,526
Michigan	14,936	11,949	2,987	20.0	93,028
Missouri	3,562,191	2,960,031	602,160	16.9	3,217,221
Montana	321,000	302,978	18,022	5.6	499,810
New Mexico	322,628	303,470	19,158	5.9	964,846
Ohio	8,247,118	6,292,400	1,954,718	23.7	8,635,747
Oklahoma	264,950	239,169	25,781	9.7	444,500
Oregon	17,979	13,072	4,907	27.3	16,500
Pennsylvania[2]	27,885,389	24,816,070	3,069,319	11.0	34,667,205
Tennessee	130,210	114,695	15,515	11.9	636,329
Utah	1,733,274	1,682,138	51,136	3.0	2,107,242
Virginia	3,896,626	3,623,548	273,078	7.0	9,079,349
Washington	1,363,774	1,114,360	249,414	18.3	1,207,045
West Virginia[3]	35,652,955	31,671,908	3,981,047	11.2	59,998,810
Total at mines only[4]	163,128,740	138,834,782	24,293,958	14.9	214,258,070
Consumer plants[5]	9,770,627	9,051,154	719,473	7.4	
Grand total	172,899,367	147,885,936	25,013,431	14.5	

[1] In Alabama (for example) for every 100 tons of raw coal cleaned in 1945, an average of 20.9 tons of refuse was discarded and 79.1 tons of clean marketable coal was obtained.
[2] Includes some coal mined in Pennsylvania and cleaned in Ohio.
[3] Includes some coal mined in West Virginia and cleaned in Ohio and Pennsylvania.
[4] Includes all mechanical cleaning other than washeries operated by consumer steel companies.
[5] Includes central washeries in Colorado and Pennsylvania operated by consumer steel companies.

DETAILED STATISTICS, BY STATES AND COUNTIES

Detailed production and employment statistics are given in table 44 for each coal-producing county in the United States from which three or more operators submitted reports for 1945. Statistics on counties with less than three reporting producers have been combined with data for other counties in the same State to avoid disclosing individual figures, unless permission to publish has been granted by the operators. Production of mines on the border between two States has been credited to the State from which the coal was extracted rather than to that in which the tipple was situated. If the coal is mined from lands in both States, the tonnage has been apportioned accordingly.

In this series the reported production is classified according to the principal methods of distribution or use. Beginning with 1932, the series was expanded to include data on the growing volume of coal moving from mine to consumer by truck. For 1933–36 this tonnage was shown as "Commercial sales by truck or wagon." In 1937 this tonnage was shown as "Truck deliveries, including local sales" (see Minerals Yearbook, 1939, p. 813). In 1938 the truck tonnage was shown as "Shipped by truck or wagon." The truck figures for 1933 to 1936, inclusive, and 1938 to 1945, inclusive, are reasonably comparable.

The data in the present report, as in those published for many years by the Bureau of Mines, relate only to mines with an annual output of 1,000 tons or more. That fact should be borne in mind when the statistics in this report are compared with similar data compiled by State mine departments. Differences arise largely from variations in coverage by State reports, some of which include data for all mines regardless of size, and others only data for mines employing more than a specified minimum number, ranging from 2 to 10 men.

Because of a change in method of reporting, statistics of average production per man per day for 1932 to 1936 and 1938 to 1941 are not precisely comparable with those for other years. For other years they were based upon the calculated number of man-shifts, obtained by multiplying the average number of men employed at each mine by the number of days worked at the mine. From 1932 to 1936 and 1938 to 1941 the operators were asked to make, if possible, a special report of the number of man-shifts actually worked. The number of operators able to furnish this information was small. These reports were utilized to improve the accuracy of the record. Otherwise, the man-shifts were calculated by multiplying the number employed underground and on the surface by the number of days worked by the mine and tipple, respectively.

TABLE 44.—Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by States and counties, in 1945

[Exclusive of mines producing less than 1,000 tons]

County	Disposition of coal produced (net tons)					Average value per ton [2]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity		Underground	Surface		Total			
								In strip pits	All others				
ALABAMA													
Bibb	744,297	28,300	5,071	19,728	797,396	$4.65	771	27	237	1,035	273	282,799	2.82
Blount	107,381	100,462	298	1,654	209,795	3.94	290	53	68	411	222	91,353	2.30
Cherokee		1,310			1,310	3.92	2			2	280	560	2.34
Cullman		40,471	80		40,551	4.50	77		15	92	225	20,744	1.95
De Kalb		1,435			1,435	3.92	2			2	280	560	2.56
Etowah		1,095			1,095	3.92	2			2	210	420	2.61
Jackson	2,334	16,283			18,617	3.99	24		5	29	255	7,392	2.52
Jefferson	8,909,971	267,010	60,585	33,217	9,270,783	4.28	9,300	176	1,738	11,214	278	3,113,724	2.98
Marion	204,660	114,016	1,771	8	320,455	4.97	357	35	71	463	247	114,292	2.80
St. Clair	775,886	38,186	7,672	33,465	855,209	4.20	737	78	138	953	257	244,991	3.49
Shelby	404,534	70,567	2,992	934	479,027	4.62	581		104	685	264	180,686	2.65
Tuscaloosa	392,279	75,900	668		468,847	3.74	353	61	78	492	259	127,646	3.67
Walker	4,797,507	576,771	366,845	1,069	5,742,192	3.95	4,147	472	954	5,573	264	1,472,709	3.90
Winston	21,009	8,787	31		29,827	4.32	7	16	5	28	171	4,790	6.23
Total Alabama	16,359,858	1,340,593	446,013	[4] 90,075	18,236,539	4.19	16,650	918	3,413	20,981	270	5,662,666	3.22
ALASKA													
Total Alaska	264,132	23,274	1,425	[4] 8,813	297,644	$6.28	267		68	335	302	101,035	2.95
ARIZONA													
Total Arizona		3,853			3,853	$3.50	7		1	8	268	2,144	1.80

ARKANSAS

Franklin	148,930	5,057	688	1,871	156,546	$4.46	168	30	39	237	196	46,402	3.37
Johnson	423,604	9,083	101	----------	432,788	4.75	324	91	79	494	221	108,951	3.97
Logan	352,001	74	2,192	----------	354,267	6.37	540	--------	84	624	246	153,297	2.31
Sebastian	719,585	31,570	445	972	752,572	4.74	513	200	146	859	216	185,814	4.05
Other counties:													
Pope and Scott	137,905	19,848	----------	----------	157,753	4.96	15	96	51	162	126	20,356	7.75
Total Arkansas	1,782,025	65,632	3,426	[4] 2,843	1,853,926	5.05	1,560	417	399	2,376	217	514,820	3.60

COLORADO

Boulder	206,527	262,254	4,027	4,291	477,099	$3.83	427	--------	71	498	223	111,225	4.29
Delta	94,811	31,134	584	4,976	131,505	2.91	83	--------	29	112	269	30,076	4.37
Elbert	----------	1,618	----------	115	1,733	2.08	3	--------	1	4	201	804	2.16
El Paso	19,718	148,700	36,346	10,442	215,206	3.49	181	--------	41	222	251	55,750	3.86
Fremont	222,361	327,427	2,348	63	552,199	4.14	377	--------	77	454	261	118,382	4.66
Garfield	20,931	35,664	2	1,440	58,037	3.84	42	--------	11	53	266	14,090	4.12
Gunnison	726,211	26,572	10,294	12,726	775,803	3.48	374	--------	112	486	287	139,379	5.57
Huerfano	814,579	61,769	4,785	1,764	882,897	3.81	653	--------	145	798	283	226,083	3.91
Jackson	6,400	4,496	----------	----------	10,896	3.61	--------	8	1	9	182	1,639	6.64
Jefferson	107,905	30,145	973	743	139,766	3.08	93	--------	18	111	256	28,392	4.92
La Plata	43,727	24,571	42	2	68,342	2.82	63	--------	9	72	199	14,347	4.76
Las Animas	1,226,642	48,541	9,083	[5] 147,942	1,432,208	3.88	1,313	--------	230	1,543	265	409,452	3.50
Mesa	85,648	20,110	614	360	106,732	3.27	81	--------	15	96	268	25,714	4.15
Moffat	91,819	29,787	6,989	----------	128,595	3.81	49	--------	12	61	292	17,828	7.21
Montrose	----------	17,404	11,957	----------	29,361	4.02	27	--------	3	30	200	5,994	4.90
Rio Blanco	----------	11,392	43	----------	11,435	3.78	10	--------	2	12	258	3,090	3.70
Routt	1,005,441	27,828	17,356	42,669	1,093,294	3.98	662	30	240	932	274	255,630	4.28
Weld	1,144,435	329,274	10,121	22,074	1,505,904	3.31	775	--------	162	937	238	223,196	6.75
Total Colorado	5,817,155	1,438,686	115,564	[5] 249,607	7,621,012	3.69	5,213	38	1,179	6,430	261	1,681,071	4.53

GEORGIA

Total Georgia	38,701	3,000	445	[4] 422	42,568	$3.85	64	10	15	89	256	22,798	1.87

See footnotes at end of table.

TABLE 44.—Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by States and counties, in 1945—Continued

County	Disposition of coal produced (net tons)					Average value per ton [3]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity		Underground	Surface		Total			
								In strip pits	All others				
ILLINOIS													
Bureau		93,994	1,134	2,149	97,277	$3.35	49	14	31	94	166	15,643	6.22
Christian	7,314,564	125,563	28,152	24,558	7,492,837	1.81	1,814		548	2,362	275	650,287	11.52
Clinton	250,734	115,013	5,332	14,045	385,124	2.39	287		56	343	228	78,119	4.93
Edgar		30,672		2,919	33,591	2.81	40		5	45	166	7,470	4.50
Franklin	16,296,707	252,839	223,592	187,216	16,960,354	2.54	5,300		1,548	6,848	277	1,899,745	8.93
Fulton	6,706,606	326,855	11,103	7,603	7,052,167	2.22	298	525	677	1,500	240	359,721	19.60
Gallatin	92,412	17,993	1,100	3,000	114,505	2.30	77	10	19	106	191	20,204	5.67
Grundy	1,249,095	163,214	4,140	4,919	1,421,368	2.75		260	182	442	305	134,772	10.55
Henry	479,957	67,895	846	476	549,174	2.48	74	50	91	215	246	52,817	10.40
Jackson	2,700,504	147,118	11,164	2,393	2,861,179	2.23	780	48	244	1,072	285	305,192	9.38
Jefferson	565,225	28,695	2,780	25,326	622,026	2.38	180		82	262	259	67,858	9.17
Knox	522,487	131,509	1,393	2,870	658,259	2.50	103	30	89	222	293	65,032	10.12
La Salle	33,958	170,171	9,027	428	213,584	3.83	208	20	49	277	169	46,922	4.55
Livingston		7,559	100		7,659	3.88		8		8	227	1,816	4.22
Logan		60,602		250	60,852	3.27	48		9	57	196	11,164	5.45
Macon		27,161	700	1,822	29,683	4.13	56		7	63	172	10,836	2.74
Macoupin	4,962,538	191,816	26,663	147,012	5,328,029	1.98	2,019		493	2,512	276	692,216	7.70
Madison	1,078,554	869,845	17,729	69,668	2,035,796	2.33	1,061		253	1,314	248	326,348	6.24
Marion	135,279	13,548	713	6,270	155,810	2.19	111		43	154	144	22,176	7.03
Menard		49,376	285	2,940	52,601	2.89	64		12	76	264	20,032	2.63
Mercer		1,400		72	1,472	4.13	3		1	4	180	720	2.04
Montgomery	830,567	33,879	2,000	49,800	916,246	2.00	232		88	320	288	92,160	9.94
Peoria	382,011	258,595	3,531	1,316	645,453	2.28	375		53	428	230	98,614	6.55
Perry	4,210,873	106,898	17,843	45,675	4,381,289	2.26	691	288	520	1,499	247	370,317	11.83
Randolph	2,593,900	107,306	8,542	27,024	2,736,772	2.23	654	57	261	972	260	252,407	10.84
St. Clair	1,580,351	1,226,253	104,464	58,825	2,969,893	2.26	1,191	92	306	1,589	225	357,678	8.30
Saline	4,471,161	62,779	25,750	53,847	4,613,537	2.64	1,569	113	627	2,309	255	587,928	7.85
Sangamon	1,920,174	606,063	17,709	24,532	2,568,478	2.39	1,652		228	1,880	231	433,437	5.93
Schuyler	129,995	64,940	6,734	115	201,784	2.50	26	29	35	81	220	17,857	11.30
Tazewell		113,968	211	629	114,808	3.26	96		18	114	220	25,073	4.58
Vermilion	1,973,735	216,641	25,996	11,344	2,227,716	2.78	1,306	21	195	1,522	263	400,227	5.57
Warren		3,398		20	3,418	3.17	3		1	4	300	1,200	2.85
Washington	450,902	83,059	2,393	17,578	553,932	2.36	242		64	306	275	84,072	6.59
Will	321,442	133,406	607	785	456,240	2.73		70	60	130	281	36,498	12.50

Williamson	4,049,045	374,785	12,513	30,738	4,467,081	2.47	1,473	117	471	2,061	243	500,512	8.93
Woodford		19,100		2,098	21,198	5.46	49		8	57	256	14,592	1.45
Total Illinois	65,302,776	6,303,908	574,246	[4] 830,262	73,011,192	2.34	22,131	[5] 1,743	7,374	31,248	258	8,061,662	[6] 9.06
INDIANA													
Clay	1,596,923	252,983	1,920	5,248	1,857,074	$2.55	40	362	233	635	230	146,214	12.70
Daviess	40,978	43,233	100	266	84,577	2.58	35	5	11	51	254	12,973	6.52
Fountain	3,760	84,485			88,245	3.42		14	13	27	321	8,669	10.18
Gibson	827,829	163,449	200	27,529	1,019,007	2.75	451		76	527	241	127,094	8.02
Greene	1,145,329	3,935	405	9,430	1,159,099	2.31	238	152	144	534	197	105,002	11.04
Knox	3,452,472	474,791	15,740	26,148	3,969,151	2.21	1,284	47	450	1,781	240	428,191	9.27
Owen		1,962			1,962	2.97		5		5	64	320	6.13
Parke		40,324	151	689	41,164	3.13	56		11	67	206	13,772	2.99
Perry		2,450			2,450	2.50	3			3	200	600	4.08
Pike	4,003,533	65,049	14,963	10,283	4,093,828	2.14	27	422	472	921	248	228,596	17.91
Spencer	77,403	127,760	175	550	205,888	3.03	22	56	23	101	201	20,344	10.12
Sullivan	2,941,315	121,948	6,794	17,830	3,087,887	2.46	902	248	401	1,551	228	353,023	8.75
Vermillion	283,076	111,940	400	3,590	399,006	2.27	76	57	77	210	183	38,361	10.40
Vigo	4,351,034	364,189	467,099	22,806	5,205,128	2.32	1,743	120	372	2,235	257	573,960	9.07
Warrick	3,663,770	252,277	4,138	587	3,920,772	2.19	343	342	351	1,036	272	281,923	13.91
Other counties:													
Dubois and Vanderburgh	9,545	36,258	200	1,370	47,373	2.94	76		12	88	138	12,163	3.89
Total Indiana	22,396,967	2,147,033	512,285	[4] 126,326	25,182,611	2.32	5,296	1,830	2,646	9,772	241	2,351,205	[6] 10.71
IOWA													
Appanoose	152,645	119,102	3,701	463	275,911	$4.00	479		60	539	198	106,590	2.59
Boone	61,191	23,166	1,438	949	86,744	3.85	100		12	112	243	27,216	3.19
Dallas	230,147	71,779	1,532	855	304,313	3.66	240		56	296	259	76,800	3.96
Davis	860	5,392			6,192	3.05		6	6	12	57	680	9.11
Greene		10,371	192	118	10,681	3.68	8		2	10	280	2,800	3.81
Guthrie		4,851	45	3	4,899	5.02	14		3	17	152	2,579	1.90
Jasper		17,370	178		17,548	4.07	21		4	25	239	5,981	2.93
Lucas	46,671	45,084	1,141	1,148	94,044	3.56	100		11	111	179	19,827	4.74
Mahaska	119,344	74,073	555	15	193,987	3.35	17	77	44	138	250	34,554	5.61
Marion	319,559	200,885	2,755	1,528	524,727	3.08	310	61	95	466	205	95,609	5.49
Monroe	125,463	74,023	2,371	462	202,319	3.32	208	5	31	244	231	56,363	3.59
Page		5,046			5,046	6.00	8		3	11	180	1,980	2.55
Polk		127,015	2,562	652	130,229	4.21	160		17	177	206	36,500	3.57
Van Buren	110	33,541	721	40	34,412	3.55	26	12	10	48	234	11,228	3.06
Wapello	2,453	122,571	520	601	126,145	3.15	70	41	19	130	193	25,055	5.03
Warren		7,088			7,088	3.14	5		1	6	300	1,800	3.94
Wayne		6,621		57	6,678	4.00	12		1	13	218	2,840	2.35
Webster	1,610	12,727	300		14,637	3.73	13		3	16	280	4,480	3.27
Total Iowa	1,059,993	960,705	18,011	[4] 6,891	2,045,600	3.51	1,791	202	378	2,371	216	512,882	3.99

See footnotes at end of table.

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TABLE 44.—Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by States and counties, in 1945—Continued

County	Disposition of coal produced (net tons)					Average value per ton [3]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity		Underground	Surface		Total			
								In strip pits	All others				
KANSAS													
Bourbon	154,124	17,437	144	1,145	172,850	$2.50	-------	46	19	65	217	14,129	12.23
Cherokee	1,203,231	55,982	3,830	1,594	1,264,637	2.49	20	246	150	416	238	98,851	12.79
Crawford	1,643,110	49,227	5,857	4,040	1,702,234	2.52	207	315	157	679	248	168,195	10.12
Leavenworth	55	3,965	44,173	885	49,078	5.00	180	-------	50	230	305	70,150	.70
Linn	-------	5,273	-------	44	5,317	4.02	14	-------	3	17	229	3,890	1.37
Osage	-------	30,234	193	-------	30,427	4.92	64	15	8	87	193	16,811	1.81
Other counties: Franklin and Labette	-------	4,016	-------	-------	4,016	4.58	5	2	1	8	235	1,878	2.14
Total Kansas	3,000,520	166,134	54,197	[4] 7,708	3,228,559	2.57	490	624	388	1,502	249	373,904	[7] 8.63
KENTUCKY													
Eastern Kentucky:													
Bell	2,489,174	429,456	25,189	186	2,944,005	$3.44	2,573	-------	449	3,022	242	732,466	4.02
Boyd	7,432	77,438	200	3,729	88,799	2.91	101	17	24	142	230	32,695	2.72
Breathitt	13,319	45,971	-------	-------	59,290	3.25	73	-------	18	91	227	20,632	2.87
Carter	58,531	134,357	556	2,769	196,213	3.14	189	-------	49	238	241	57,398	3.42
Clay	171,462	151,021	127	-------	322,610	3.43	435	36	113	584	208	121,514	2.65
Floyd	6,535,070	77,897	17,730	204	6,630,901	3.35	4,530	-------	834	5,364	255	1,366,811	4.85
Greenup	-------	16,200	-------	-------	16,200	2.81	26	-------	4	30	232	6,960	2.33
Harlan	11,404,815	112,815	95,737	[8] 10,954	11,624,321	3.53	8,596	-------	1,498	10,094	267	2,690,718	4.32
Jackson	-------	108,459	131	3,722	112,312	3.06	137	-------	42	179	244	43,647	2.57
Johnson	710,301	23,967	5,452	1,855	741,575	3.76	669	-------	106	775	253	195,876	3.79
Knott	884,841	11	4,161	-------	889,013	3.26	586	-------	71	657	258	169,683	5.24
Knox	502,777	178,480	3,554	500	685,311	3.28	647	-------	125	772	232	178,780	3.83
Laurel	272,526	353,190	716	-------	626,432	3.22	430	90	98	618	238	147,117	4.26
Lawrence	1,935	13,735	60	627	16,357	2.93	28	-------	6	34	210	7,149	2.29
Lee	5,691	22,280	100	50	28,121	3.15	56	-------	10	66	232	15,294	1.84
Leslie	250,654	38,113	-------	-------	288,767	3.74	188	-------	43	231	252	58,104	4.97

Letcher	5,445,901	645,369	40,849	5,985	6,138,104	3.41	4,612	-------	735	5,347	246	1,314,196	4.67
Magoffin	110,215	7,510	20	-------	117,745	3.19	116	-------	20	136	271	36,829	3.20
Martin	425,766	21,248	420	-------	447,434	2.90	237	-------	51	288	238	68,662	6.52
McCreary	851,146	77,902	10,271	13,650	952,969	3.40	664	-------	94	758	287	217,733	4.38
Menifee	-------	21,207	120	-------	21,327	3.03	27	-------	6	33	276	9,120	2.34
Morgan	-------	15,000	-------	-------	15,000	3.50	19	-------	4	23	212	4,868	3.08
Perry	5,771,935	96,041	128,743	1,450	5,998,169	3.33	4,276	53	762	5,091	254	1,290,595	4.65
Pike	8,639,315	469,851	85,220	[8] 128,541	9,322,927	3.07	6,035	47	1,406	7,488	257	1,926,923	4.84
Pulaski	12,898	237,681	428	-------	251,007	3.07	170	27	39	236	265	62,452	4.02
Rockcastle	5,422	57,310	190	28	62,950	2.75	64	9	16	89	229	20,424	3.08
Wayne	-------	24,631	44	-------	24,675	3.49	32	-------	7	39	253	9,872	2.50
Whitley	249,823	252,915	4,639	-------	507,377	3.34	479	18	125	622	223	138,938	3.65
Wolfe	-------	6,600	-------	-------	6,600	2.98	11	-------	2	13	201	2,608	2.53
Other counties: Clinton and Elliott	-------	12,031	-------	22	12,053	2.89	12	4	3	19	254	4,818	2.50
Total Eastern Kentucky	44,820,949	3,728,686	424,657	[8] 174,272	49,148,564	3.35	36,018	301	6,760	43,079	254	10,952,882	4.49
Western Kentucky:													
Butler	-------	282,112	-------	-------	282,112	$2.44	168	14	44	226	266	60,112	4.69
Christian	1,068	26,625	-------	-------	27,693	2.66	20	12	12	44	149	6,536	4.24
Daviess	139,163	337,793	161	162	477,279	2.43	238	32	65	335	247	82,718	5.77
Edmonson	-------	31,500	-------	-------	31,500	2.38	48	-------	9	57	208	11,845	2.66
Hancock	-------	58,784	-------	-------	58,784	2.72	48	-------	12	60	250	15,005	3.92
Henderson	3,235	200,312	112	1,749	205,408	1.99	191	-------	37	228	219	49,886	4.12
Hopkins	10,279,359	536,023	24,460	6,101	10,845,943	2.18	2,615	420	953	3,988	258	1,028,901	10.54
McLean	17,240	68,600	-------	-------	85,840	2.61	75	-------	11	86	237	20,350	4.22
Muhlenberg	5,364,473	666,346	20,868	27,528	6,079,215	2.15	2,311	142	624	3,077	255	784,086	7.75
Ohio	337,753	302,507	1,593	-------	641,853	2.37	318	30	112	460	244	112,253	5.72
Union	690,762	81,651	-------	8,428	780,841	2.07	315	-------	60	375	268	100,476	7.77
Webster	809,387	117,580	257	680	927,904	2.15	408	44	91	543	214	116,174	7.99
Total Western Kentucky	17,642,440	2,709,833	47,451	44,648	20,444,372	2.18	6,755	694	2,030	9,479	252	2,388,342	[6] 8.56
Total Kentucky	62,463,389	6,438,519	472,108	[8] 218,920	69,592,936	3.00	42,773	995	8,790	52,558	254	13,341,224	5.22
MARYLAND													
Allegany	808,089	229,807	3,636	241	1,041,773	$3.74	747	109	142	998	257	256,645	4.06
Garrett	649,210	64,922	3,835	2,963	720,930	3.41	582	32	123	737	257	189,394	3.81
Total Maryland	1,457,299	294,729	7,471	[4] 3,204	1,762,703	3.61	1,329	141	265	1,735	257	446,039	3.95
MICHIGAN													
Bay	-------	11,130	309	1,846	13,285	$5.42	21	-------	6	27	266	7,182	1.85
Saginaw	-------	18,016	349	1,026	19,391	5.85	31	-------	6	37	260	9,620	2.02
Tuscola	49,803	36,062	984	6,179	93,028	5.40	90	-------	19	109	271	29,539	3.15
Total Michigan	49,803	65,208	1,642	[4] 9,051	125,704	5.47	142	-------	31	173	268	46,341	2.71

See footnotes at end of table.

TABLE 44.—Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by States and counties, in 1945—Continued

County	Disposition of coal produced (net tons)					Average value per ton [3]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity		Underground	Surface		Total			
								In strip pits	All others				
MISSOURI													
Adair	36,014	83,035	200	2,109	121,358	$3.27	161		31	192	226	43,353	2.80
Barton	189,452	52,362	649	5	242,468	2.63	27	57	31	115	199	22,888	10.59
Bates	989,744	3,097	724		993,565	2.36		116	100	216	233	50,429	19.70
Boone		51,410			51,410	2.10		11	2	13	272	3,534	14.55
Callaway		189,076	30	300	189,406	2.76		65	30	95	307	29,130	6.50
Clay		45,586	1,064	419	47,069	4.66	96		13	109	169	18,390	2.56
Dade		7,450	30		7,480	4.06		9		9	235	2,118	3.53
Daviess		10,300	270		10,570	5.43	21		2	23	257	5,911	1.79
Harrison		5,007	78	630	5,715	3.93	14		3	17	256	4,358	1.31
Henry	553,118	90,177			643,295	2.30		97	43	140	246	34,392	18.70
Jasper		4,505			4,505	3.25		6		6	218	1,308	3.44
Johnson	43,465	9,039			52,504	2.38		12	3	15	246	3,694	14.21
Lafayette	6,732	54,375	1,687	720	63,514	4.40	150		21	171	221	37,805	1.68
Linn	2,230	15,515			17,745	3.74	33		6	39	201	7,850	2.26
Macon	434,623	89,018	1,922		525,563	2.36	74	88	82	244	228	55,632	9.45
Moniteau		1,067			1,067	2.89		3		3	99	297	3.59
Monroe		6,484			6,484	3.24		9		9	308	2,772	2.34
Putnam		15,729	60		15,789	3.94	38		6	44	200	8,807	1.79
Randolph	426,122	55,814	70		482,006	2.57	94	47	59	200	225	44,916	10.73
Ray	8,132	59,965	990		69,087	4.97	149		18	167	212	35,381	1.95
Vernon	330,800	100,104	1,200	20	432,124	2.56		119	25	144	248	35,683	12.11
Total Missouri	3,020,432	949,115	8,974	[4] 4,203	3,982,724	2.59	857	639	475	1,971	228	448,648	[7] 8.88

MONTANA

Montana bituminous coal:													
Carbon	524,664	34,570	4,594	743	564,571	$3.35	211	-------	99	310	245	75,807	7.45
Cascade	186,879	22,780	183	120	209,962	2.17	101	-------	15	116	190	22,044	9.52
Musselshell	1,030,613	45,060	5,625	2,874	1,084,172	2.70	402	-------	183	585	276	161,261	6.72
Rosebud	2,552,403	----------	----------	2,805	2,555,208	1.17	-------	86	20	106	303	32,122	79.55
Other counties:													
Blaine and Chouteau	----------	11,243	35	----------	11,278	4.47	18	-------	3	21	233	4,891	2.31
Total bituminous coal	4,294,559	113,653	10,437	6,542	4,425,191	1.88	732	86	320	1,138	260	296,125	[6] 14.94
Montana lignite	----------	[5] 41,597	(9)	----------	41,597	2.38	31	2	7	40	196	7,828	5.31
Total Montana	4,294,559	155,250	10,437	[4] 6,542	4,466,788	1.89	763	88	327	1,178	258	303,953	[6] 14.70

NEW MEXICO

Bernalillo	----------	3,089	30	----------	3,119	$4.32	4	-------	1	5	207	1,035	3.01
Colfax	1,079,657	7,776	4,593	3,408	1,095,434	3.53	585	-------	151	736	302	222,328	4.93
McKinley	222,016	37,765	2,708	34,477	296,966	4.66	282	8	87	377	217	81,678	3.64
Rio Arriba	14,280	4,249	25	----------	18,554	3.37	21	-------	6	27	180	4,856	3.82
Sandoval	----------	4,347	4	----------	4,351	4.50	8	-------	2	10	134	1,342	3.24
San Juan	----------	14,627	100	----------	14,727	3.31	29	-------	4	33	194	6,390	2.30
Santa Fe	26,342	14,764	967	6,165	48,238	4.77	68	-------	45	113	310	35,030	1.38
Socorro	----------	2,197	----------	100	2,297	5.37	8	-------	2	10	184	1,840	1.25
Total New Mexico	1,342,295	88,814	8,427	[4] 44,150	1,483,686	3.80	1,005	8	298	1,311	270	354,499	4.19

NORTH DAKOTA (LIGNITE)

Total North Dakota	2,023,257	430,445	[5] 47,486	[4] 21,131	2,522,319	$1.56	227	282	248	757	226	171,251	[6] 14.73

OHIO

Athens	1,777,556	96,414	10,901	1,200	1,886,071	$3.28	1,333	66	396	1,795	210	377,326	5.00
Belmont	7,810,890	257,187	36,437	3,013	8,107,527	2.85	3,998	305	846	5,149	262	1,347,453	6.02
Carroll	210,468	250,049	2,136	32	462,685	2.88	220	55	49	324	254	82,310	5.62
Columbiana	161,789	624,859	649	94	787,391	2.88	118	144	77	339	246	83,316	9.45
Coshocton	35,625	315,984	819	1,543	353,971	3.92	240	34	57	331	210	69,391	5.10
Gallia	27,912	90,875	30	----------	118,817	3.11	108	-------	19	127	249	31,593	3.76
Guernsey	246,491	109,709	1,262	775	358,237	2.97	312	19	46	377	212	80,004	4.48
Harrison	6,416,394	39,863	7,813	13,878	6,477,948	2.63	934	647	529	2,110	263	554,860	11.67
Hocking	533,606	131,155	307	----------	665,068	3.26	414	74	107	595	203	120,962	5.50
Holmes	----------	33,386	18	19	33,423	2.81	17	10	17	44	166	7,310	4.57

See footnotes at end of table.

TABLE 44.—Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by States and counties, in 1945—Continued

County	Disposition of coal produced (net tons)					Average value per ton [3]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity		Underground	Surface		Total			
								In strip pits	All others				
OHIO—Continued													
Jackson	86,357	84,573	17,933	30	188,893	$3.52	176	17	39	232	229	53,186	3.55
Jefferson	5,102,148	850,171	15,211	6,035	5,973,565	2.77	1,373	477	661	2,511	256	643,211	9.29
Lawrence	1,664	80,021	213	203	82,101	2.41	100		15	115	244	28,060	2.93
Mahoning	13,009	167,696	347	2,024	183,076	3.06	14	63	17	94	195	18,358	9.97
Meigs	320,369	62,508	260	5	383,142	3.00	278	10	70	358	248	88,657	4.32
Morgan	345,757	28,655	200		374,612	2.94	177	20	44	241	282	67,955	5.51
Muskingum	1,013,878	204,927	1,431	420	1,220,656	2.27	647	60	138	845	211	177,904	6.86
Noble	198,979	22,963			221,942	1.81		52	20	72	143	10,298	21.55
Perry	2,373,541	221,771	4,483	103	2,599,898	2.81	1,121	357	369	1,847	202	373,849	6.95
Stark		253,651	372		254,023	2.93	36	63	29	128	251	32,129	7.91
Tuscarawas	116,988	1,616,705	386	573	1,734,652	2.56	500	199	133	832	260	216,153	8.03
Vinton	55,453	85,852	114	45	141,464	3.17	47	65	22	134	204	27,295	5.18
Wayne		42,503			42,503	2.57	9	23	12	44	94	4,116	10.33
Other counties:													
Portage and Washington		85,770			85,770	2.83	3	17	4	24	339	8,144	10.53
Total Ohio	26,848,874	5,757,247	101,322	[4] 29,992	32,737,435	2.79	12,175	2,777	3,716	18,668	241	4,503,840	[6] 7.27
OKLAHOMA													
Coal	275,266	36,708	61		312,035	$4.05	32	69	43	144	224	32,205	[7] 9.69
Craig		8,216			8,216	3.42		8		8	234	1,872	4.39
Haskell	107,667	2,207	289		110,163	3.98	131	36	26	193	172	33,119	3.33
Latimer	27,982	8,770	38		36,790	4.67	36	19	22	77	128	9,829	3.74
Le Flore	281,836	11,627	387	3,192	297,042	5.13	423		82	505	211	106,545	2.79
Muskogee	134,753	3,592			138,345	2.84		51	15	66	266	17,530	[7] 7.89
Okmulgee	671,168	26,473		1,621	699,262	3.65	407	20	77	504	274	137,983	5.07
Pittsburg	235,093	6,989	468	3,271	245,821	4.82	324	11	80	415	194	80,547	3.05
Rogers	412,871	33,976	216	6,792	453,855	2.75		91	59	150	262	39,226	[7] 11.57
Tulsa	3,174	10,494	28	30	13,726	4.71	27		7	34	244	8,280	1.66
Wagoner	571,924	21,797			593,721	2.72		81	53	134	246	32,900	[7] 18.05
Total Oklahoma	2,721,734	170,849	1,487	[4] 14,906	2,908,976	3.61	1,380	386	464	2,230	224	500,036	5.82

OREGON

Total Oregon	7,718	8,752	30	----------	16,500	$3.99	24	--------	13	37	192	7,104	2.32

PENNSYLVANIA (BITUMINOUS COAL)

Allegheny	13,298,176	2,581,731	1,175,068	4,351	17,059,326	$3.13	8,051	860	1,648	10,559	261	2,757,876	6.19
Armstrong	5,623,703	151,007	48,608	566	5,823,884	3.15	3,045	385	671	4.101	249	1,021,709	5.70
Beaver	32,394	262,822	192	90	295,498	3.08	123	67	44	234	254	59,367	4.98
Bedford	680,210	92,778	1,353	----------	774,341	3.88	607	94	111	812	245	198,843	3.89
Blair	40,585	93,787	1,051	----------	135,423	3.77	119	6	22	147	272	39,958	3.39
Butler	673,111	528,392	11,632	43	1,213,178	3.21	540	249	158	947	249	235,708	5.15
Cambria	14,031,437	709,431	1,625,813	[10] 211,491	16,578,172	3.61	11,897	321	2,466	14,684	264	3,870,118	4.28
Cameron	----------	3,471	----------	----------	3,471	2.19	4	----------	----------	4	200	800	4.34
Centre	1,105,192	243,846	1,065	156	1,350,259	3.19	682	266	193	1,141	241	274,664	4.92
Clarion	2,628,337	363,658	10,014	190	3,002,199	2.96	775	527	281	1,583	260	411,898	[7] 7.29
Clearfield	6,280,178	367,351	11,554	27,780	6,686,863	3.36	2,689	1,410	954	5,053	220	1,110,872	[7] 6.02
Clinton	22,006	74,867	5	20	96,898	3.01	54	11	17	82	234	19,183	5.05
Elk	344,707	161,934	2,310	18,832	527,783	3.28	462	11	100	573	244	139,896	3.77
Fayette	15,388,155	1,576,184	192,526	[10] 3,589,940	20,746,805	3.29	12,401	351	1,723	14,475	265	3,838,854	5.40
Forest	----------	5,865	----------	----------	5,865	3.00	5	----------	3	8	311	2,488	2.36
Greene	6,885,076	19,626	17,740	15,714	6,938,156	3.24	3,884	109	865	4,858	253	1,227,597	5.65
Huntingdon	596,315	156,892	4,927	2,400	760,534	3.92	423	199	97	719	255	183,304	4.15
Indiana	8,755,764	335,059	339,201	[10] 326,629	9,756,653	3.24	4,921	692	1,179	6,792	256	1,735,612	5.62
Jefferson	1,798,037	223,413	29,031	4,133	2,054,614	3.14	1,282	241	266	1,789	233	416,787	4.93
Lawrence	----------	137,060	[12]	4	137,076	3.01	20	25	13	58	245	14,207	[7] 9.65
Lycoming	----------	43,816	120	----------	43,936	3.31	33	8	9	50	247	12,373	3.55
Mercer	333,454	229,594	2,402	56	565,506	3.27	109	89	44	242	265	64,137	[7] 8.82
Somerset	6,979,825	253,984	27,240	48,175	7,309,224	3.46	4,224	383	921	5,528	268	1,480,511	4.94
Tioga	130,366	88,586	343	3,646	222,941	3.88	157	34	37	228	256	58,274	3.83
Venango	7,227	45,308	----------	----------	52,535	3.24	10	12	6	28	183	5,128	[7] 10.24
Washington	18,601,384	702,771	326,607	34,339	19,665,101	3.27	11,104	846	2,116	14,066	260	3,653,282	5.38
Westmoreland	8,486,501	1,258,848	206,540	[10] 1,185,944	11,137,833	3.10	5,341	736	1,070	7,147	254	1,815,990	6.13
Other counties:													
Bradford and McKean	----------	21,219	40	10	21,269	3.24	5	15	8	28	171	4,775	4.45
Total Pennsylvania	112,722,140	10,733,300	4,035,394	[10] 5,474,509	132,965,343	3.29	72,967	7,947	15,022	95,936	257	24,654,211	5.39

SOUTH DAKOTA (LIGNITE)

Total South Dakota	5,360	[9] 19,085	([9])	----------	24,445	$2.17	4	11	--------	15	259	3,881	6.30

See footnotes at end of table.

TABLE 44.—Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by States, and counties, in 1945—Continued

County	Disposition of coal produced (net tons)					Average value per ton [3]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity		Underground	Surface		Total			
								In strip pits	All others				
TENNESSEE													
Anderson	1,190,531	6,677	9,522	410	1,207,140	$3.34	854	19	153	1,026	247	253,572	4.76
Bledsoe	40,613	4,162	574		45,349	3.37	69		10	79	178	14,084	3.22
Campbell	1,471,584	19,822	33,066	1,300	1,525,772	3.72	1,229	29	258	1,516	254	384,978	3.96
Claiborne	1,308,143	46,919	19,380	139	1,374,581	3.35	1,097		224	1,321	233	308,406	4.46
Fentress	233,688	28,281	2,131		264,100	3.25	188		29	217	283	61,480	4.30
Grundy	381,065		9,760	690	391,515	3.64	391		56	447	242	108,281	3.62
Hamilton	140,552	12,369	50		152,971	3.42	79	48	18	145	194	28,086	5.45
Marion	496,790	63,887	7,725	1,307	569,709	3.32	682		120	802	229	183,730	3.10
Morgan	115,481	9,095	1,435	11,283	137,294	2.48	163		32	195	241	46,917	2.93
Overton	110,016	4,042	14,517	765	129,340	3.22	108		21	129	269	34,705	3.73
Putnam	59,326	48,018			107,344	3.50	83		14	97	249	24,153	4.44
Scott	242,791	4,300	1,298		248,389	3.15	218	14	40	272	217	58,970	4.21
Sequatchie	42,149	46,160	53	25	88,387	3.62	140		20	160	226	36,151	2.44
Van Buren	400	1,080			1,480	3.43	5		1	6	206	1,236	1.20
White		5,800			5,800	2.89	8		1	9	204	1,840	3.15
Other counties: Cumberland and Rhea	10,281	10,956	100	200	21,537	3.39	42		9	51	190	9,676	2.23
Total Tennessee	5,843,410	311,568	99,611	[4] 16,119	6,270,708	3.43	5,356	110	1,006	6,472	240	1,556,265	4.03
TEXAS (LIGNITE)													
Total Texas	79,051		898		79,949	$0.85		19	7	26	158	4,096	[7] 19.52

UTAH

Carbon	4,245,856	95,497	39,367	[11] 14,356	4,395,076	$3.47	1,795	-------	661	2,456	293	718,846	6.11
Emery	2,097,790	67,550	4,211	11,424	2,180,975	3.32	893	-------	265	1,158	293	338,982	6.43
Garfield	----------	1,382	14	3	1,399	3.00	2	-------	-------	2	150	300	4.66
Grand	37,189	----------	132	----------	37,321	3.22	19	-------	6	25	296	7,400	5.04
Iron	----------	9,577	----------	----------	9,577	3.61	10	-------	1	11	257	2,827	3.39
Kane	----------	2,985	----------	----------	2,985	3.50	4	-------	-------	4	230	920	3.24
Sevier	----------	31,186	----------	----------	31,186	3.08	32	-------	7	39	162	6,335	4.92
Summit	3,682	15,862	----------	----------	19,544	2.50	11	-------	4	15	209	3,129	6.25
Uintah	----------	1,000	----------	----------	1,000	4.36	5	-------	1	6	200	1,200	.83
Total Utah	6,384,517	225,039	43,724	[11] 25,783	6,679,063	3.41	2,771	-------	945	3,716	291	1,079,939	[12] 6.18

VIRGINIA

Buchanan	5,165,219	22,628	19,943	----------	5,207,790	$3.35	2,803	28	535	3,366	286	961,382	5.42
Dickenson	1,561,956	3,186	12,348	750	1,578,240	3.35	1,194	-------	232	1,426	291	414,635	3.81
Lee	803,050	59,753	11,904	1,235	875,942	3.46	725	-------	126	851	258	219,812	3.98
Montgomery	166,428	16,034	2,245	1,196	185,903	3.55	157	-------	41	198	263	52,030	3.57
Russell	965,532	62,890	11,125	995	1,040,542	3.35	842	-------	124	966	265	256,144	4.06
Scott	----------	26,552	3,362	----------	29,914	3.30	36	-------	6	42	238	9,975	3.00
Tazewell	3,989,948	16,360	41,273	13,620	4,061,201	3.78	3,218	-------	708	3,926	283	1,112,103	3.65
Wise	3,832,460	105,150	26,195	[13] 291,656	4,255,461	3.22	3,202	70	614	3,886	269	1,044,545	4.07
Total Virginia	16,484,593	312,553	128,395	[13] 309,452	17,234,993	3.43	12,177	98	2,386	14,661	278	4,070,626	4.23

WASHINGTON

King	179,852	256,481	2,671	155	439,159	$5.66	356	65	109	530	260	137,956	3.18
Kittitas	595,415	29,851	20,029	10,687	655,982	4.91	384	35	162	581	286	166,350	3.94
Lewis	10,323	58,392	349	45	69,109	4.32	65	-------	11	76	282	21,451	3.22
Pierce	8,201	7,955	120	24	16,300	5.52	16	-------	2	18	236	4,244	3.84
Thurston	54,318	8,621	436	----------	63,375	3.44	37	-------	9	46	231	10,626	5.96
Whatcom	70,854	37,790	903	3,772	113,319	5.56	93	-------	31	124	285	35,318	3.21
Total Washington	918,963	399,090	24,508	[4] 14,683	1,357,244	5.12	951	100	324	1,375	273	375,945	3.61

WEST VIRGINIA

Barbour	2,876,358	6,631	6,630	31	2,889,650	$2.76	928	290	342	1,560	253	394,425	[12] 7.33
Boone	4,610,062	67,416	28,647	1,000	4,707,125	3.33	2,601	27	673	3,301	260	859,785	5.47
Braxton	15,660	8,306	32	----------	23,998	2.85	29	-------	6	35	232	8,124	2.95
Brooke	736,981	308,151	896,878	213	1,942,223	2.79	627	177	150	954	258	246,325	[6] 7.88
Clay	1,144,928	10,642	14,328	24,912	1,194,810	3.30	600	4	142	746	292	217,781	5.49
Fayette	11,875,881	32,031	410,241	[14] 198,721	12,516,874	3.57	7,847	371	1,521	9,739	277	2,698,359	4.64

See footnotes at end of table.

TABLE 44.—Production, value, employment, days active, man-days, and output per man per day at bituminous-coal and lignite mines in the United States, by States and counties, in 1945—Continued

County	Disposition of coal produced (net tons)					Average value per ton [3]	Average number of employees				Average number of days mines were active	Number of man-days worked	Average tons per man per day
	Loaded for shipment by rail or water [1]	Shipped by truck or wagon (excluding coal used by mine employees)	Used by mine employees, taken by locomotive tenders at tipple, or other uses at mine [2]	Used at mine for power and heat or made into beehive coke at mine	Total quantity		Underground	Surface		Total			
								In strip pits	All others				
WEST VIRGINIA—Continued													
Gilmer	8,939	5,343			14,282	$2.13	9	4	5	18	162	2,912	4.90
Grant		26,938	50		26,988	3.54	41		9	50	263	13,164	2.05
Greenbrier	2,489,931	41,217	13,583	443	2,545,174	3.67	1,388	165	281	1,834	270	494,515	5.15
Hancock		69,936	55	1,042	71,033	2.88	3	36	11	50	153	7,665	[7] 9.27
Harrison	12,524,215	239,972	66,754	135	12,831,076	2.80	2,591	1,515	1,204	5,310	240	1,271,975	[6] 10.09
Kanawha	7,593,985	149,415	52,136	6,660	7,802,196	3.25	5,016		953	5,969	277	1,651,687	4.72
Lewis		15,279	196	1	15,476	2.50	16		4	20	193	3,852	4.02
Logan	20,946,701	9,847	135,962	25,400	21,117,910	3.07	9,631		2,820	12,451	266	3,315,421	[13] 6.37
Marion	9,510,018	183,368	455,069	23,189	10,171,644	2.85	4,501	196	1,074	5,771	261	1,506,689	[13] 6.75
Marshall	705,562	88,033	209,197	17,474	1,020,266	3.05	590	11	105	706	271	191,582	[6] 5.33
Mason	113,513	137,664	479		251,656	3.15	137		49	186	250	46,505	5.41
McDowell	23,044,889	98,443	304,732	76,964	23,525,028	3.31	13,886	23	2,986	16,895	288	4,872,807	4.83
Mercer	2,785,144	13,365	31,960	767	2,831,236	3.62	1,980		564	2,544	288	732,141	3.87
Mineral	313,732	22,644	481		336,857	3.75	140	59	52	251	215	53,939	[7] 6.25
Mingo	5,028,164	25,409	38,223	157	5,091,953	3.17	2,991	26	605	3,622	273	989,364	[13] 5.15
Monongalia	9,368,423	309,093	13,442	[14] 36,341	9,727,299	2.74	3,659	159	1,085	4,903	254	1,243,914	[13] 7.82
Nicholas	1,359,734	25,969	5,379	[14] 19,635	1,410,717	3.41	865	54	136	1,055	271	285,873	4.93
Ohio	1,373,687	189,472	12,348	10	1,575,517	3.04	1,096		165	1,261	271	341,619	4.61
Preston	1,738,781	42,707	116,839	[14] 169,161	2,067,488	3.17	1,244	135	307	1,686	266	448,859	4.61
Raleigh	14,086,842	49,690	132,053	48,611	14,317,196	3.54	9,320	163	1,874	11,357	279	3,163,424	4.53
Randolph	1,812,739	80,063	9,415	19,488	1,921,705	3.29	1,042	117	269	1,428	265	378,101	5.08
Taylor	1,228,328	177,905	1,942		1,408,175	2.91	489	130	125	744	232	172,915	[6] 8.14
Tucker	687,217	5,355	3,171	26,752	722,495	3.60	382	65	84	531	264	140,384	5.15
Upshur	478,735	38,840	925	3,822	522,322	2.73	288	22	69	379	251	95,222	5.49
Wayne	324,209	11,800	12		336,021	2.15	233		53	286	240	68,699	4.89
Webster	1,942,933	11,972	7,674	2,345	1,964,924	3.42	961		269	1,230	291	358,154	5.49
Wyoming	5,027,038	22,790	40,184	21,337	5,111,349	3.57	3,017		684	3,701	268	991,346	[13] 5.16
Other counties:													
Lincoln and Putnam	4,988	16,256	25	800	22,069	2.60	35		10	45	186	8,358	2.64
Total West Virginia	145,758,317	2,541,962	3,009,042	[14] 725,411	152,034,732	3.20	78,183	3,749	18,686	100,618	271	27,275,885	5.57

WYOMING

Carbon	1,437,237	13,409	4,327	27,093	1,482,066	$2.62	272	70	127	469	335	156,980	9.44
Fremont		7,825	40		7,865	3.99	10		4	14	203	2,845	2.76
Hot Springs	131,893	22,327	100	3,049	157,369	4.15	106		25	131	283	37,043	4.25
Johnson		6,595	105	275	6,975	2.94	6		3	9	200	1,797	3.88
Lincoln	496,140	1,079	3,385	280	500,884	3.38	263		72	335	296	99,140	5.05
Sheridan	1,256,486	28,604	2,287	1,343	1,288,720	2.31	226	39	94	359	266	95,368	13.51
Sweetwater	6,137,804	12,809	33,557	67,120	6,251,290	2.93	2,555		623	3,178	326	1,036,031	6.03
Uinta	2,041	1,949			3,990	3.11	6		2	8	79	632	6.31
Other counties:													
Campbell, Converse, and Teton	110,228	28,488	552	9,148	148,416	1.89	4	20	24	48	189	9,095	16.32
Total Wyoming	9,571,829	123,085	44,353	[4] 108,308	9,847,575	2.83	3,448	129	974	4,551	316	1,438,931	[6] 6.84

UNITED STATES

Total United States	518,019,667	41,477,428	9,770,921	8,349,311	577,617,327	$3.06	290,001	23,261	69,838	383,100	261	99,866,901	5.78

[1] Includes coal loaded at mine directly into railroad cars or river barges, hauled by truck to railroad siding for shipment by rail, and hauled by truck to waterway for shipment by water.

[2] Includes coal transported from mine to point of use by conveyor or tram.

[3] Value received or charged for coal, f. o. b. mine, including selling cost. (Includes a value for coal not sold but used by producer, such as mine fuel and coal coked [not coke] as estimated by producer at average prices that might have been received if such coal had been sold commercially.)

[4] No coal was "Made into beehive coke at mine."

[5] Includes 129,837 tons "Made into beehive coke at mine" in Las Animas County.

[6] Output obtained chiefly from strip pits and by use of mechanical loading devices, in which types of operations production per man per day is large.

[7] Output obtained chiefly from strip pits in which production per man per day is large.

[8] Includes coal "Made into beehive coke at mine" in following counties: Harlan, 3,975 tons; Pike, 120,178—grand total, 124,153 tons.

[9] In Montana and South Dakota some lignite included in "Shipped by truck or wagon" includes "Other uses at mine." In North Dakota some lignite made into briquets is included in "Other uses at mine."

[10] Includes coal "Made into beehive coke at mine" in following counties: Cambria, 5,424 tons; Fayette, 3,568,964; Indiana, 233,996; and Westmoreland, 1,151,994—grand total, 4,960,378 tons.

[11] Includes 7,889 tons "Made into beehive coke at mine" in Carbon County.

[12] Output is obtained chiefly by use of mechanical devices in which type of operation production per man per day is large.

[13] Includes 284,785 tons "Made into beehive coke at mine" in Wise County.

[14] Includes coal "Made into beehive coke at mine" in following counties: Fayette, 176,585 tons; Monongalia, 35,955; Nicholas, 19,635; and Preston, 167,696—grand total, 399,871 tons.

STATISTICS ON LIGNITE IN 1945 [3]

PRODUCTION

The output of lignite in 1945, exclusive of small mines producing less than 1,000 tons, totaled 2,668,310 net tons. As for many years, North Dakota was the chief producer, followed in order by Texas, Montana, and South Dakota. The North Dakota output comprised 95 percent of the total production and that of Texas, South Dakota, and Montana together totaled 5 percent.

The average value per ton was $1.55. Employees engaged in the production of lignite numbered 838 and the average output per man per day, based upon calculated man-days, was 14.26 tons. The output per man per day in the lignite industry is high when compared with other coal-mining operations in the United States because a large part of the total production (74 percent in 1945) is recovered from strip pits where the daily production per man is much greater than in deep mining. Lignite mines reporting an annual production of more than 1,000 tons in 1945 totaled 65.

According to the Federal Power Commission, the West North Central States consumed 668,636 tons of lignite in generating electric

TABLE 45.—Summary of production, value, men employed, days operated, man-days of labor, and output per man per day at lignite mines in the United States in 1945, by States [1]

	Montana [2]	North Dakota	South Dakota	Texas	Total
Production (net tons):					
Loaded at mines for shipment		2,023,257	5,360	79,051	2,107,668
Commercial sales by truck or wagon	[3] 41,597	430,445	[3] 19,085		491,127
Used by employees, taken by locomotives at tipple, and other uses	([3])	[4] 47,486	([3])	898	48,384
Used at mine for power and heat		21,131			21,131
Total production: 1945	41,597	2,522,319	24,445	79,949	2,668,310
1944	51,709	2,366,092	26,827	109,532	2,554,160
Value:					
Total: 1945	$99,000	$3,924,000	$53,000	$68,000	$4,144,000
1944	$113,000	$3,535,000	$55,000	$95,000	$3,798,000
Average per ton: 1945	$2.38	$1.56	$2.17	$0.85	$1.55
1944	$2.19	$1.49	$2.05	$0.87	$1.49
Number of employees:					
Underground	31	227	4		262
Surface (including strip pits)	9	530	11	26	576
Total employees: 1945	40	757	15	26	838
1944	55	826	28	36	945
Average number of days mines operated:					
1945	196	226	259	158	223
1944	173	213	177	198	209
Man-days of labor: 1945 [5]	7,828	171,251	3,881	4,096	187,056
Average output (tons) per man per day: 1945 [5]	5.31	14.73	6.30	19.52	14.26

[1] Exclusive of small mines producing less than 1,000 tons. In 1944 tonnage from such mines amounted to 22,644 net tons.
[2] Includes output from Custer, Dawson, McCone, Richland, Roosevelt, and Sheridan Counties.
[3] Some "Other uses" included in "Commercial sales by truck or wagon."
[4] Includes some lignite made into briquets.
[5] Based upon calculated man-days.

[3] Compiled by J. A. Corgan and M. I. Cooke.

energy during 1945; the West South Central States consumed 39 tons; and the Mountain States 338,130 tons, a large part of which was sub-bituminous.

This report was prepared by the Bureau of Mines from an annual canvass of operators of lignite properties included in the areas mapped as "lignite" in Geological Survey Professional Paper 100–A, The Coal Fields of the United States. Sub-bituminous coal is not included.

TABLE 46.—Production, value, men employed, days operated, man-days of labor, and output per man per day at lignite mines in the United States in 1945, by States and counties

County	Total production (net tons)	Value		Total number of employees	Man days of labor [1]	Average number of days mine operated	Average tons per man per day [1]
		Total (thousand dollars)	Average per ton				
MONTANA							
Custer	15,080	37	$2.45	13	1,992	153	7.57
Dawson	2,560	6	2.34	4	720	180	3.56
McCone	1,133	3	2.65	2	270	135	4.20
Richland	6,409	14	2.18	8	1,600	200	4.01
Roosevelt	2,933	12	4.09	6	1,356	226	2.16
Sheridan	13,482	27	2.00	7	1,890	270	7.13
Total Montana	41,597	99	2.38	40	7,828	196	5.31
NORTH DAKOTA							
Adams	60,633	111	$1.83	36	3,973	110	[2] 15.26
Bowman	4,495	11	2.45	7	1,050	150	4.28
Burke	414,833	616	1.48	74	16,364	221	[2] 25.35
Burleigh	222,586	382	1.72	69	13,973	203	15.93
Divide	206,709	277	1.34	32	7,168	224	[2] 28.84
Dunn	4,834	13	2.69	6	1,200	200	4.03
Grant	17,700	44	2.49	10	1,698	170	[2] 10.42
Hettinger	20,281	49	2.42	15	3,073	205	[2] 6.60
McKenzie	5,938	15	2.53	8	1,068	134	5.56
McLean	46,605	115	2.47	61	10,835	178	4.30
Mercer	848,455	1,239	1.46	230	60,179	262	[2] 14.10
Morton	21,462	57	2.66	27	5,413	200	3.96
Oliver	5,500	9	1.64	5	950	190	[2] 5.79
Stark	77,347	132	1.71	50	12,883	258	6.00
Ward	548,060	816	1.49	111	29,249	264	[2] 18.74
Williams	16,881	38	2.25	16	2,175	136	7.76
Total North Dakota	2,522,319	3,924	1.56	757	171,251	226	14.73
SOUTH DAKOTA							
Dewey	17,092	34	$1.99	8	2,416	302	[2] 7.07
Harding	1,833	5	2.73	2	400	200	4.58
Perkins	5,520	14	2.54	5	1,065	213	[2] 5.18
Total South Dakota	24,445	53	2.17	15	3,881	259	6.30
TEXAS							
Total Texas: Milam	79,949	68	$0.85	26	4,096	158	[2] 19.52

[1] Based upon "calculated" man-days.
[2] Output is obtained chiefly from strip pits in which production per man per day is large.

METHODS OF RECOVERY

TABLE 47.—Lignite mined by different methods in the United States in 1945, by States, in net tons

	Montana	North Dakota	South Dakota	Texas	Total
From underground workings:					
Mined by hand		12,943			12,943
Shot off the solid	40,464	26,168	3,033		69,665
Cut by machines [1]		623,534			623,534
Total underground	40,464	662,645	3,033		706,142
From strip pits	1,133	1,859,674	21,412	79,949	1,962,168
Grand total production	41,597	2,522,319	24,445	79,949	2,668,310

[1] A total of 16 machines was used—13 "permissible" and 3 other types.

NUMBER AND SIZE OF MINES

The Bureau received reports for 1945 from 65 lignite mines (exclusive of mines producing less than 1,000 tons a year). Of the total output, 7 mines producing over 100,000 net tons each supplied 80 percent; 3 mines, with an output of 50,000 to 100,000 tons, 7 percent; 10 mines, with 10,000 to 50,000 tons, 8 percent; and 45 mines, producing less than 10,000 tons, 5 percent. North Dakota, with 53, had the largest number of lignite operations; Montana was next, with 7 mines; and South Dakota and Texas followed, with 4 and 1, respectively. The classification, by size of output, in the field as a whole is given in table 48.

TABLE 48.—Number and production of lignite mines in the United States in 1945, classified by size of output

Class	Mines		Production		
			Net tons		Percent of total
	Number	Percent	Total	Average per mine	
1 (100,000 tons and over)	7	10.8	2,122,778	303,254	79.6
2 (50,000 and under 100,000)	3	4.6	192,967	64,322	7.2
3 (10,000 and under 50,000)	10	15.4	203,146	20,315	7.6
4 (Under 10,000 tons)	45	69.2	149,419	3,320	5.6
Total	65	100.0	2,668,310	41,051	100.0

STRIPPING OPERATIONS

Of the total 1945 production, 74 percent, or 1,962,168 tons, was produced from strip pits. Most of the stripping—that is, 95 percent of all strip-pit production and 70 percent of the total tonnage produced by the entire lignite industry—was done in North Dakota, where 1,859,674 tons were produced by that method. The stripping output of operations in Texas, Montana, and South Dakota totaled only

102,494 tons. The number of men employed in stripping operations was 482, with an average output per man per day of 18.66 tons; the average number of days worked was 218.

Detailed statistics for stripping operations in the lignite industry in 1945 are given in table 49.

TABLE 49.—Summary of stripping operations that produced lignite in the United States in 1945, by States

	Montana	North Dakota	South Dakota	Texas	Total
Number of strip pits [1]	1	30	2	1	34
Number of shovels, dragline excavators, and coal-loading machines [2]	1	43	2	2	48
Coal produced by stripping	1,133	1,859,674	21,412	79,949	1,962,168
Total value at mines	$3,000	$2,841,000	$45,000	$68,000	$2,957,000
Average value per ton	$2.65	$1.53	$2.10	$0.85	$1.51
Number of employees:					
In strip pits	2	282	11	19	314
All others		161		7	168
Total	2	443	11	26	482
Average number of days mines operated	135	220	295	158	218
Man-days of labor [3]	270	97,573	3,241	4,096	105,180
Average tons per man per day [3]	4.20	19.06	6.61	19.52	18.66

[1] Includes some pits in which stripping is done by hand.
[2] In some cases the same equipment was used for stripping or excavating and for loading coal; this duplication has been eliminated. In some cases coal was excavated by machine and loaded by hand.
[3] Based upon calculated man-days.

IMPORTS AND EXPORTS [4]

TABLE 50.—Bituminous coal [1] imported for consumption in the United States, 1944–46, by countries and customs districts, in net tons

COUNTRY	1944	1945	1946
North America:			
Canada	631,988	466,565	434,130
Mexico		1	
South America:			
Chile	68		
Colombia	16		
Peru		7	
Europe:			
Poland and Danzig			538
U. S. S. R.	370		
United Kingdom	1,221	577	
Oceania:			
Australia		318	
New Zealand		2	
Africa: Union of South Africa	26	3	12
	633,689	467,473	434,680

CUSTOMS DISTRICT	1944	1945	1946
Alaska	19,930		2,929
Chicago		2	
Dakota	340	491	548
Duluth and Superior	166	327	135
Los Angeles	68		
Maine and New Hampshire	108,709	105,020	133,039
Michigan	[2]	84	44
Montana and Idaho	430,734	276,055	242,668
New York	1,263	731	550
Oregon	370		
Philadelphia	866		
Pittsburgh		8	
St. Lawrence		97	925
San Francisco		16	
Vermont		786	1,528
Virginia		151	
Washington	71,243	83,643	52,164
Wisconsin		62	150
	633,689	467,473	434,680

[1] Includes slack, culm, and lignite.
[2] Less than 1 ton.

[4] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 51.—Exports of bituminous coal to Canada and Mexico, the West Indies and Central America, and "overseas" destinations, 1942–46, in thousands of net tons

Year	Canada and Mexico	West Indies and Central America [1]	"Overseas" (all other countries)							Grand total
			Newfoundland, Miquelon, Bermuda, Greenland, and Iceland	South America	Europe	Asia	Africa	Oceania	Total "overseas"	
1942	21,017	440	90	925	253	4	214	-------	1,486	22,943
1943	24,272	462	111	589	294	------	108	-------	1,102	25,836
1944	24,369	356	157	580	218	[2]	352	-------	1,307	26,032
1945	21,581	295	191	1,080	3,916	[2]	873	11	6,071	27,947
1946	21,882	253	160	1,723	16,065	201	878	37	19,064	41,199

[1] Includes Bahamas and Panama.
[2] Less than 1,000 net tons.

TABLE 52.—Bituminous coal exported from the United States, 1944–46, by countries, in net tons [1]

Country	1944	1945	1946
North America:			
Bermuda	6,873	8,234	2,555
Canada	24,366,929	21,578,281	21,879,705
Central America:			
British Honduras	38	424	76
Costa Rica	2,551	26	62
El Salvador	96	71	77
Guatemala	172	190	253
Honduras	619	400	262
Nicaragua	48	3	10
Panama:			
Canal Zone	53,626	25,667	9,554
Republic of	13	12	50
Greenland	1,170	940	4,110
Mexico	2,981	2,629	1,688
Newfoundland and Labrador	149,050	181,663	153,212
West Indies:			
British:			
Barbados	3,572	2,006	1,269
Jamaica	45,741	38,102	65,604
Trinidad and Tobago	73,739	110,252	68,038
Other British	4,002	2,318	24
Cuba	148,559	99,706	99,798
Curaçao (N. W. I.)	347	971	63
Dominican Republic	1,985	971	3,175
French	20,469	13,661	5,504
Haiti	36	35	----------
	24,882,616	22,066,562	22,295,089
South America:			
Argentina	196,165	313,784	486,809
Bolivia	26,571	5,240	28,211
Brazil	289,434	665,112	1,083,379
Chile	15,991	6,359	17,372
Falkland Islands	94	106	----------
Surinam	4,345	2,218	577
Uruguay	46,944	86,879	105,458
Other South America	211	821	787
	579,755	1,080,519	1,722,593
Europe:			
Azores	----------	4,698	1,608
Belgium and Luxembourg	----------	436,644	878,373
Denmark	----------	199,244	1,059,596

See footnote at end of table.

TABLE 52—Bituminous coal exported from the United States, 1944–46 by countries in net tons [1]—Continued

Country	1944	1945	1946
Europe—Continued			
France		624,378	5,092,481
Gibraltar		144,603	9,330
Greece		37,351	91,676
Italy		1,102,351	4,687,950
Netherlands		433,773	1,607,383
Norway		353,610	744,277
Portugal	213,370	344,746	455,024
Spain	4,507	112	
Sweden		134,496	860,854
Switzerland		98,787	307,586
U. S. S. R.	300		
United Kingdom	49	1,245	
Other Europe			268,481
	218,226	3,916,038	16,064,619
Asia:			
British Malaya			58,940
China			88,321
French Indo-China			14,494
Hong Kong			39,696
Other Asia	35	26	11
	35	26	201,462
Africa:			
Algeria	279,480	561,830	551,350
British West Africa		47,220	
Canary Islands	20,748	12,555	
Cape Verde Islands	13,962	7,620	25,685
Egypt	1		85,399
French West Africa		67,229	40,505
Madeira Islands	9,073	14,123	27,838
Morocco:			
French		76,348	47,031
Spanish	25,693	15,725	
Tunisia	2,753	70,245	99,931
Other Africa	6	9	5
	351,716	872,904	877,744
Oceania		10,555	37,487
	26,032,348	27,946,604	41,198,994

[1] Amounts stated do not include fuel or bunker coal loaded on vessels engaged in foreign trade, which aggregated 1,559,335 tons in 1944, 1,784,956 tons in 1945, and 1,380,514 tons in 1946.

TABLE 53.—Bituminous coal exported from the United States, 1944–46, by customs districts, in net tons

Customs district	1944	1945	1946
North Atlantic:			
Maine and New Hampshire	11,009	12,087	33,495
Massachusetts	2		1,691
New York	26,164	36,027	701,602
Philadelphia	307,671	1,160,647	2,482,437
Rhode Island			73
South Atlantic:			
Maryland	168,541	2,264,127	6,459,560
North Carolina			4,501
South Carolina		294,753	1,369,553
Virginia	1,021,447	1,643,106	4,428,458
Gulf Coast:			
Florida	286,731	982,251	1,363,403
Galveston		89,128	633,911
Mobile	57,716	347,207	809,566
New Orleans	25,910	19,650	20,129
Sabine			531,302
Mexican border:			
Arizona	428	338	264
El Paso	1,612	277	58
Laredo	1	21	27

TABLE 53.—Bituminous coal exported from the United States, 1944–46, by customs districts, in net tons—Continued

Customs district	1944	1945	1946
Pacific Coast:			
Los Angeles	394		334,727
Oregon			138,019
San Diego	82	164	92
San Francisco	300	14	15
Washington	640	1,020	92,037
Northern border:			
Buffalo	1,696,135	1,413,882	1,580,304
Chicago	1,582,563	583,981	1,199,033
Dakota	7,478	15,555	30,360
Duluth and Superior	365,798	273,868	300,414
Michigan	1,821,036	2,297,837	2,369,744
Montana and Idaho		9	48
Ohio	12,094,748	10,825,722	10,433,093
Rochester	3,318,098	3,155,747	2,899,833
St. Lawrence	3,227,283	2,523,021	2,876,940
Vermont	5,049	1,263	2,517
Wisconsin	125	468	538
Miscellaneous:			
Alaska	5,387	78	413
Hawaii			70,346
Minnesota			5,984
Pittsburgh		4,356	3,381
Puerto Rico			4
St. Louis			12,298
	26,032,348	27,946,604	[1] 41,198,994

[1] Includes 8,824 tons, representing export shipments (except by air) individually valued under $25, data for which are not separately classified by customs districts after January 1, 1946.

TABLE 54.—Shipments of bituminous coal to noncontiguous Territories, 1944–46

Territory	1944		1945		1946	
	Net tons	Value	Net tons	Value	Net tons	Value
Alaska:						
Anthracite	39,964	$491,412	36,599	$464,053	7,865	$111,451
Bituminous						
Hawaii	429	13,965	567	17,586	259	7,174
Puerto Rico	11,428	73,333	8,220	50,204	11,526	73,121
Virgin Islands			32,168	218,066	53,771	361,170

WORLD PRODUCTION

TABLE 55.—World production of coal and lignite, 1939–46, by countries, in thousands of metric tons [1]

[Compiled by B. B. Mitchell]

Country [1]	1939	1940	1941	1942	1943	1944	1945	1946
North America:								
Canada:								
Coal	10,985	12,638	12,872	13,018	11,591	14,201	13,584	14,765
Lignite	3,094	3,298	3,662	4,096	4,610	1,245	1,391	1,381
Greenland	[2]	6	7	5	7	8	7	8
Mexico	628	816	856	914	1,025	904	915	[3]
United States:								
Anthracite (Pennsylvania)	46,708	46,706	51,136	54,728	55,015	57,789	49,835	[3]
Bituminous	355,445	415,336	463,908	525,948	532,903	559,750	521,582	482,620
Lignite	2,760	2,666	2,518	2,659	2,494	2,317	2,421	
South America:								
Argentina [4]	[5]	[5]	[5]	5	8	[3]	[3]	[3]
Brazil	1,047	1,049	1,110	1,354	1,556	1,433	1,501	[6] 1,252
Chile	1,609	1,639	1,717	1,782	2,032	2,047	1,827	1,740
Colombia	349	521	403	415	476	499	[3]	[3]
Peru	108	153	117	150	187	173	201	230
Venezuela	3	5	6	9	11	12	7	4

See footnotes at end of table.

TABLE 55.—World production of coal and lignite, 1939–46, by countries, in thousands of metric tons [1]—Continued

Country [1]	1939	1940	1941	1942	1943	1944	1945	1946
Europe:								
Albania: Lignite [6]	16	20	20	20	10	5	5	(3)
Austria:								
Coal	217	228	226	225	214	196	72	104
Lignite	3,533	3,614	3,537	3,523	3,646	3,674	2,066	2,330
Belgium	29,843	25,599	26,608	24,929	23,743	13,505	15,718	22,779
Bulgaria:								
Coal	164	188	2,256	2,781	[6] 2,000	2,327	2,868	(3)
Lignite	2,134	2,700						
Czechoslovakia:								
Coal	18,691	20,820	20,930	22,635	24,500	23,159	[7] 6,019	14,153
Lignite	18,614	21,476	21,623	23,316	26,750	26,112	[7] 8,238	19,417
Denmark: Lignite	----------	200	1,000	1,800	2,600	2,200	2,320	2,300
Eire	120	118	155	167	186	206	216	(3)
Faroe Islands: Lignite	8	(2)	(2)	(2)	(2)	(3)	(3)	(3)
France:								
Coal	49,147	39,323	41,849	41,869	40,531	25,241	35,061	49,500
Lignite	1,102	1,661	2,008	1,958	1,896	1,336		
Germany:								
Coal	187,945	240,101	243,607	251,970	(2)	(3)	(3)	[6] [8] 51,066
Lignite	210,939	223,946	234,996	244,643	(2)	(3)	(3)	[6] [8] 63,027
Greece: Lignite	139	250	180	365	370	190	70	(3)
Hungary:								
Coal [9]	1,107	1,207	1,301	1,250	1,376	[6] 9,000	4,021	722
Lignite [9]	9,518	10,306	11,298	11,720	11,296			5,630
Italy:								
Coal	2,024	2,282	2,393	2,522	439	(3)	612	1,180
Lignite	1,099	2,109	2,030	2,306	1,934	(3)	709	1,496
Netherlands:								
Coal	12,861	12,145	13,356	12,330	12,497	8,313	5,085	8,314
Lignite	197	199	199	281	383	243	130	499
Poland:								
Coal	[10] 65,536	[10] 77,077	[10] 76,343	[10] 83,972	[10] 91,362	[10] 87,389	27,366	47,288
Lignite	(2)	(2)	(2)	(2)	(2)	(3)	(3)	857
Portugal:								
Coal	299	369	435	438	403	426	436	[6] 369
Lignite	35	64	84	108	106	127	146	135
Rumania:								
Coal	286	297	264	285	306	202	[6] 125	(3)
Lignite	2,179	2,384	2,195	2,367	2,604	2,069	[6] 1,625	(3)
Spain:								
Coal	6,606	8,862	8,763	9,257	9,591	10,485	10,636	10,749
Lignite	194	569	793	1,106	1,112	1,202	1,305	1,330
Svalbard (Spitsbergen)	625	565	(2)	(2)	(2)	(3)	(3)	[11] 63
Sweden	444	498	557	582	557	570	615	(3)
Switzerland:								
Coal	3	8	72	184	157	71	311	179
Lignite	----------	----------	8	27	75	74		
U. S. S. R.:								
Coal	134,500	148,700	146,800	[6] 90,000	[6] 131,400	[6] 118,000	[6] 145,000	[6] 160,000
Lignite	(2)	15,900	(2)	(2)	(3)	(3)	(3)	(3)
United Kingdom:								
Great Britain	235,051	227,898	209,656	206,901	197,615	184,322	172,347	[12] 131,164
Northern Ireland:								
Coal	(5)	(5)	(5)	3	(5)	(5)	(5)	(3)
Lignite	----------	(5)	(5)	1	1	2	3	(3)
Yugoslavia:								
Coal	444	[13] 3,170	7,310	[13] [14] 1,160	(3)	(3)	(3)	(3)
Lignite	5,622							
Asia:								
British Borneo	(5)	(2)	(2)	(2)	(3)	(3)	(3)	(3)
China:								
China (including Manchuria):								
Coal	38,210	46,481	58,426	65,267	[15] 5,995	[15] 4,425	(3)	(3)
Lignite	331	346	397	419	(3)	(3)	(3)	(3)
Formosa (Taiwan)	(2)	(2)	2,886	2,311	(2)	(3)	(3)	[6] 1,200
Federated Malay States	448	794	(2)	(2)	(2)	(3)	(3)	(3)
India	28,214	29,860	29,937	29,906	25,921	26,546	29,635	29,747
Indochina:								
Coal	2,588	2,470	2,329	1,243	1,020	537	(3)	(3)
Lignite	27	30						
Iran [16]	(2)	75	92	90	82	69	108	(3)
Japan:								
Japan proper: [17]								
Coal	52,409	57,309	55,602	54,179	55,539	49,335	22,371	22,500
Lignite	195	298	408	1,607	2,876	2,304	1,643	2,319
Karafuto	(2)	(2)	(2)	(2)	(2)	(2)	(3)	(3)
Korea (Chosen)	4,481	(2)	(2)	(2)	(2)	7,619	(3)	(3)

See footnotes at end of table.

TABLE 55.—World production of coal and lignite, 1939–46, by countries, in thousands of metric tons[1]—Continued

Country[1]	1939	1940	1941	1942	1943	1944	1945	1946
Asia—Continued								
Netherlands Indies	1,781	2,009	[18] 778	(2)	(2)	(3)	(3)	73
Philippine Islands	47	(2)	(2)	(2)	(2)	(3)	(3)	20
Syria and Lebanon:								
Lignite	1	2	8	7	1	2	2	(3)
Turkey:								
Coal	2,696	3,019	3,020	2,510	3,166	3,560	3,720	3,830
Lignite	151	219	264	409	589	699	721	508
U. S. S. R.:								
Coal	(2)	(2)	(2)	(2)	(2)	(3)	(3)	(3)
Lignite								
Africa:								
Algeria:								
Coal	19	55	80	148	117	120	162	215
Lignite			3	7	1	1	(3)	(3)
Belgian Congo: Coal	27	23	30	43	69	49	45	(3)
Madagascar			1	2	1	2	3	(3)
Morocco, French	116	143	139	119	102	134	179	222
Nigeria	311	313	(2)	(2)	(2)	640	(3)	(3)
Portuguese East Africa	8	20	17	7	13	16	12	(3)
Southern Rhodesia	1,118	1,291	1,412	1,561	1,779	1,808	1,669	1,613
Tunisia: Lignite	2	23	102	141	41	66	69	95
Union of South Africa	16,890	17,176	18,337	20,408	20,561	22,987	23,554	23,635
Oceania:								
Australia:								
New South Wales	11,376	9,703	11,955	12,433	11,714	11,280	10,402	
Queensland	1,339	1,306	1,477	1,663	1,727	1,686	1,661	
Tasmania	99	84	111	137	148	146	151	
Victoria:								14,099
Coal	371	272	332	318	292	262	251	5,487
Lignite	3,710	4,347	4,639	5,013	5,173	5,097	5,538	
Western Australia	566	548	566	591	540	567	552	
New Zealand:								
Coal	1,061	1,163	1,199	1,194	1,157	1,085	980	2,302
Lignite	1,319	1,393	1,483	1,529	1,676	1,766	1,899	
Total, all grades	1,647,000	1,799,000	1,854,000	1,883,000	1,713,000	(3)	(3)	(3)
Lignite (total of items shown above)	287,000	302,000	317,000	323,000	279,000	(3)	(3)	(3)
Bituminous coal and anthracite (by subtraction)	1,360,000	1,497,000	1,537,000	1,560,000	1,434,000	(3)	(3)	(3)

[1] Coal is also mined in Italian East Africa, but production figures are not available.
[2] Estimate included in total.
[3] Data not yet available.
[4] In addition, the following quantities of asphaltite were produced and used as solid fuel in the years: 1939, 1,320; 1940, 9,117; 1941, 16,646; 1942, 56,387; 1943, 105,625 tons; data for later years are not available.
[5] Production of less than 1,000 tons.
[6] Estimate.
[7] May to December, inclusive.
[8] Western Germany.
[9] Includes Northern Territories and Sub-Carpathia; in addition, beginning in 1941, includes Eastern Hungary and Transylvania; and beginning in 1942 includes Southern Territories.
[10] Includes that part of Germany which is under Polish Administration (east of the Oder and Misse Rivers).
[11] Exports.
[12] January to September, inclusive.
[13] Estimated production of Croatia only.
[14] January to June, inclusive.
[15] Free China.
[16] Fiscal year ended March 20 of year stated.
[17] Preliminary and subject to revision.
[19] Production of Government mines only.

Coal—Pennsylvania Anthracite

By J. A. CORGAN AND MARIAN I. COOKE

	PAGE		PAGE
General summary	349	Stocks	380
Salient statistics	350	Prices	380
Outlook	355	Employment	383
Sources and acknowledgments	356	Mining methods and equipment	385
Production	356	Foreign trade	388
Value of sales	368	Canada	389
Shipments	370	World production	390
Consumption	377		

GENERAL SUMMARY

PRODUCTION of Pennsylvania anthracite in 1946 totaled 60,506,873 net tons, a gain of 10 percent over the output in 1945. The increase in production is attributable to several factors: (1) A more plentiful supply of labor, (2) less costly labor disturbances in 1946 than in 1945, and (3) the lifting of Government restrictions on mining equipment, which enabled the operators to obtain necessary supplies more readily. Of the total production, 63 percent was obtained from deep mines, 21 percent from strip pits, 14 percent from culm banks, and 2 percent from the rivers and creeks draining the anthracite fields. The output of 12,858,930 tons from strip-pit operations was the highest on record, and tonnage of anthracite loaded mechanically underground reached a peak of 15,619,162 tons, both reflecting the ability of the producers to obtain equipment and supplies more readily. A strike of the anthracite miners in June caused a loss of 1,600,000 tons for the year, compared with a loss of 3,500,000 tons due to a strike in May 1945. The industry operated 271 days against 269 days in 1945. Exports reached a peak of 6,506,829 tons; the large increase over 1945 is due principally to the heavy shipments of Buckwheat Nos. 4 and 5 sizes to Europe.

Anthracite was distributed widely during the 1945–46 coal year. Of the total shipments from mines, 89 percent was destined to the New England and Middle Atlantic States, Maryland, Delaware, and the District of Columbia; other States received 4 percent. Shipments to Canada and other foreign countries accounted for 7 percent.

Statistical Trends.—Tables 1 and 2 present pertinent statistical data on the Pennsylvania anthracite industry.

TABLE 1.—Salient statistics of Pennsylvania anthracite industry, 1942–46

	1942	1943	1944	1945	1946
Production:					
Loaded at mines for shipment:					
Breakers—net tons	51,173,756	[1] 50,812,873	53,067,227	45,249,706	50,115,427
Washeries—do	1,957,926	[1] 2,401,065	3,492,187	2,551,426	3,106,521
Dredges—do	778,019	821,899	1,081,156	741,319	886,639
Sold to local trade and used by employees—net tons	4,059,403	4,233,732	3,765,641	4,273,864	4,435,536
Used at collieries for power and heat—net tons	2,358,625	2,374,051	2,295,152	2,117,594	1,962,750
Total production—do	60,327,729	60,643,620	63,701,363	54,933,909	60,506,873
Value at breaker, washery, or dredge	$271,673,000	$306,816,018	$354,582,884	$323,944,435	$413,417,070
Average sales realization per net ton on breaker shipments:					
Domestic:					
Lump and Broken	$6.03	$6.77	$7.47	$8.02	$9.23
Egg	$6.24	$6.96	$7.56	$8.13	$9.38
Stove	$6.26	$6.96	$7.57	$8.10	$9.40
Chestnut	$6.28	$6.97	$7.58	$8.12	$9.42
Pea	$4.85	$5.48	$6.11	$6.62	$7.79
Total domestic	$6.05	$6.76	$7.38	$7.93	$9.21
Steam:					
Buckwheat No. 1	$3.46	$4.00	$4.52	$4.79	$5.53
Buckwheat No. 2 (Rice)	$2.63	$3.12	$3.59	$3.91	$4.52
Buckwheat No. 3 (Barley)	$1.89	$2.25	$2.53	$2.65	$3.11
Buckwheat No. 4	$1.17	$1.55	$1.82	$1.85	$2.09
Other (including silt)	$0.83	$1.13	$1.39	$1.58	$1.90
Total steam	$2.58	$3.02	$3.42	$3.56	$4.08
Total all sizes	$4.79	$5.38	$5.91	$6.26	$7.25
Percent by sizes in total breaker shipments:					
Domestic:					
Lump and Broken	0.3	0.4	0.3	0.3	0.3
Egg	5.2	7.1	7.1	6.5	6.3
Stove	23.6	22.4	21.9	21.7	22.0
Chestnut	24.9	24.5	25.2	25.5	25.8
Pea	9.6	8.7	8.3	7.8	7.4
Total domestic	63.6	63.1	62.8	61.8	61.8
Steam:					
Buckwheat No. 1	14.5	14.2	14.2	14.1	13.9
Buckwheat No. 2 (Rice)	8.0	8.3	8.5	8.1	7.8
Buckwheat No. 3 (Barley)	9.6	9.9	9.7	9.9	9.8
Buckwheat No. 4	3.3	3.0	3.1	3.6	4.0
Other (including silt)	1.0	1.5	1.7	2.5	2.7
Total steam	36.4	36.9	37.2	38.2	38.2
Producers' stocks [2]—net tons	798,000	329,000	445,000	130,000	251,168
Exports [3]—do	4,439,000	4,139,000	4,186,000	3,691,000	6,506,829
Imports [3]—do	140,000	166,000	12,000	149	9,556
Consumption (apparent)—do	56,500,000	57,100,000	59,400,000	51,600,000	53,900,000
Average number of days worked	239	270	292	269	271
Man-days lost on account of strikes and lock-outs	279,641	[4]	[4]	[4]	[4]
Number of men on strike during year	26,631	[4]	[4]	[4]	[4]
Average number of men employed	82,121	79,153	77,591	72,842	78,145
Output per man per day—net tons	2.95	2.78	2.79	2.79	2.84
Output per man per year—do	705	751	815	751	770
Quantity cut by machines—do	2,285,640	1,624,883	1,336,082	1,210,171	1,232,828
Quantity mined by stripping—do	9,070,933	8,989,387	10,953,030	10,056,325	12,858,930
Quantity loaded by machines underground—net tons	14,741,459	14,745,793	14,975,146	13,927,955	15,619,162
Distribution:					
Total receipts in New England [5]—net tons	5,974,000	5,722,000	6,222,000	5,081,000	5,643,076
Exports to Canada [3]—do	4,418,000	4,097,000	4,144,000	3,393,000	4,513,637
Loaded into vessels at Lake Erie [6]—net tons	575,000	661,000	1,066,000	1,234,000	1,112,996
Receipts at Duluth-Superior [7]—do	222,000	302,000	580,000	766,000	639,900

[1] Small quantity of washery coal included under "Breakers."
[2] Anthracite Committee.
[3] U. S. Department of Commerce.
[4] Data not available.
[5] Commonwealth of Massachusetts, Division on the Necessaries of Life; and Association of American Railroads.
[6] Ore and Coal Exchange, Cleveland, Ohio.
[7] U. S. Engineer Office, Duluth, Minn.

TABLE 2.—Statistical summary of monthly developments in the Pennsylvania anthracite industry in 1946

[All tonnage figures represent net tons]

	1946														1945 (total)
	January	February	March	April	May	June	July	August	September	October	November	December	Total	Change from 1945 (percent)	
Production (including mine fuel, local sales, and dredge coal)	4,968,000	4,774,000	5,476,000	5,069,000	5,453,000	3,625,000	5,248,000	5,428,000	5,033,000	5,393,000	4,975,000	5,065,000	60,507,000	+10.1	54,934,000
Shipments (breakers and washeries only, all sizes):															
By rail [1]	3,762,782	3,808,171	4,464,210	4,177,699	4,508,455	3,170,637	4,495,746	4,793,488	4,511,592	4,563,943	4,362,239	4,457,085	51,076,047	+13.3	45,086,717
By truck [2]	840,188	759,560	907,944	693,878	788,441	362,683	360,788	424,292	526,893	660,330	667,114	665,979	7,658,090	+0.8	7,596,109
Distribution:															
Lake Erie loadings [3]	----------	----------	----------	112,393	170,347	130,960	148,559	92,531	125,297	183,105	140,990	8,814	1,112,996	−9.8	1,233,586
Lake Ontario loadings [4]	----------	----------	----------	20,945	41,023	18,731	48,211	31,274	34,751	41,328	15,550	----------	251,813	−26.3	341,774
Receipts at Duluth-Superior [5]	----------	----------	----------	8,749	84,296	114,368	107,684	60,821	61,613	129,289	73,080	----------	639,900	−16.4	765,543
Upper Lake dock trade: [6]															
Receipts:															
Lake Superior	----------	----------	----------	15,751	92,756	114,365	102,498	69,015	69,103	132,462	88,236	6,573	690,759	−14.1	804,509
Lake Michigan	1,164	1,746	4,193	36,650	97,204	23,148	60,303	35,794	45,365	54,825	34,650	10,723	405,765	−2.8	417,660
Deliveries (reloadings):															
Lake Superior	79,513	55,763	32,510	6,664	15,241	43,289	80,502	71,742	77,031	82,689	87,753	86,529	719,226	+2.6	701,020
Lake Michigan	39,776	31,004	20,090	22,201	55,415	27,203	43,585	38,793	36,265	42,609	30,369	30,410	417,720	+4.8	398,418
New England receipts:															
By tide [7]	32,538	23,752	29,182	41,629	51,595	18,745	39,379	36,925	31,851	43,258	19,387	30,384	398,625	+20.3	331,277
By rail [8]	387,143	452,111	425,745	397,537	416,014	303,180	493,620	484,738	464,044	509,865	444,809	465,645	5,244,451	+10.4	4,749,621
Exports [9]	317,126	313,773	381,657	387,193	546,258	365,914	657,289	761,359	717,361	545,500	556,160	957,239	6,506,829	+76.3	3,691,247
Imports [9]	----------	----------	----------	----------	----------	1,323	1,485	----------	1,869	3,932	906	41	9,556	+6,313.4	149
Industrial consumption and stocks by:															
Railroads (class 1 only): [7]															
Consumption	191,611	98,364	88,691	87,960	108,159	65,370	59,055	61,752	56,820	65,410	80,640	115,196	1,079,028	+6.9	1,009,038
Stocks	98,849	101,754	103,948	114,719	130,291	117,613	117,498	122,792	122,855	119,211	122,045	117,860	117,860	+3.6	113,745
Electric-power utilities: [10]															
Consumption	260,843	243,791	246,291	281,906	352,450	249,476	273,047	295,566	302,712	294,905	317,397	334,942	3,453,326	+10.6	3,121,653
Stocks	1,543,821	1,513,336	1,555,653	1,552,993	1,494,661	1,483,673	1,545,642	1,594,580	1,643,366	1,728,947	1,717,136	1,703,659	1,703,659	+7.6	1,583,515
Stocks on Upper Lake Docks: [6]															
Lake Superior	177,644	116,311	74,312	83,399	160,913	231,989	254,165	251,438	243,510	293,283	293,766	213,808	213,808	−16.9	257,158
Lake Michigan	88,985	59,727	43,830	58,279	100,068	96,013	112,731	109,732	118,832	131,048	135,329	115,642	115,642	−9.4	127,597
Producers' stocks [11]	157,117	191,984	213,810	175,705	79,236	63,459	82,719	93,976	132,300	200,108	235,604	251,168	251,168	+93.0	130,135
Sales of mechanical stokers: [9]															
Class 1 (capacity under 61 lb. of coal per hour)	410	690	610	569	451	508	590	697	826	897	505	291	7,044	+111.8	3,325
Class 2 (capacity 61 to 100 lb. of coal per hour)	84	84	34	92	46	39	70	120	96	114	89	40	908	−51.8	1,883

See footnotes at end of table.

TABLE 2.—Statistical summary of monthly developments in the Pennsylvania anthracite industry in 1946—Continued

	1946														1945 (total)
	January	February	March	April	May	June	July	August	September	October	November	December	Total	Change from 1945 (percent)	
Prices at mines, average per net ton: [12]															
Group No. 1:															
Company Stove	$9.00	$9.00	$9.00	$9.00	$9.00	$9.23	$10.15	$10.15	$10.15	$10.15	$10.15	$10.15	$9.59	+14.2	$8.40
Company Buckwheat No. 1	$5.25	$5.25	$5.25	$5.25	$5.25	$5.39	$5.95	$5.95	$5.95	$5.95	$5.95	$5.95	$5.61	+13.8	$4.93
Group No. 2:															
Company Stove	$9.50	$9.50	$9.50	$9.50	$9.50	$9.73	$10.65	$10.65	$10.65	$10.65	$10.65	$10.65	$10.09	+19.5	$8.44
Company Buckwheat No. 1	$5.70	$5.70	$5.70	$5.70	$5.70	$5.84	$6.40	$6.40	$6.40	$6.40	$6.40	$6.40	$6.06	+22.2	$4.96
Wholesale prices: [13]															
On tracks, destination:															
Chestnut	$12.45	$12.47	$12.47	$12.47	$12.48	$12.73	$13.62	$13.58	$13.59	$13.59	$13.60	$13.62	$13.06	+9.8	$11.89
Pea	$10.96	$10.96	$10.96	$10.96	$10.97	$11.20	$11.99	$11.95	$11.97	$11.97	$11.97	$11.99	$11.49	+10.4	$10.41
Index number (1926=100)	103.9	104.0	104.0	104.0	104.1	106.1	114.5	113.4	113.5	113.5	113.5	113.7	109.0	+10.1	99.0
Labor conditions: [13]															
Average weekly earnings	$48.63	$56.84	$56.10	$52.08	$57.47	$59.58	$49.53	$60.65	$60.67	$61.82	$56.57	$65.82	$57.15	+16.7	$48.98
Average hourly earnings	$1.339	$1.376	$1.376	$1.352	$1.382	$1.559	$1.562	$1.598	$1.611	$1.593	$1.582	$1.615	$1.494	+19.3	$1.252
Average hours worked per week	36.4	41.2	41.0	38.6	41.7	38.2	31.7	37.9	37.7	39.2	35.7	40.9	38.3	−2.3	39.2
Index of employment (1939 average=100)	79.3	81.1	81.7	81.4	81.0	79.0	81.4	82.0	82.2	83.2	82.9	83.0	81.6	+12.4	72.6
Index of payroll totals (1939 average=100)	149.3	178.3	178.5	165.1	180.4	182.7	156.5	193.3	194.0	199.9	182.3	212.3	181.1	+31.3	137.9

[1] Furnished by Anthracite Institute.
[2] Pennsylvania Department of Mines.
[3] Ore and Coal Exchange, Cleveland, Ohio.
[4] Buffalo Branch, Ore and Coal Exchange, Cleveland, Ohio.
[5] U. S. Engineer Office, Duluth, Minn.
[6] Includes all commercial docks on Lake Superior and west shore of Lake Michigan as far south as Kenosha. Based on data courteously supplied by Maher Coal Bureau and direct reports to the Bureau of Mines.
[7] Association of American Railroads.
[8] Furnished by Commonwealth of Massachusetts, Division on the Necessaries of Life.
[9] U. S. Department of Commerce.
[10] Federal Power Commission.
[11] Anthracite Committee. Represents coal in storage on nearest available date to the end of the month.
[12] Computed from weekly quotations from trade journals. Figures represent circular prices quoted on white ash by leading anthracite-producing companies.
[13] Bureau of Labor Statistics.

Anthracite Institute.—The Anthracite Institute expanded its research program on different phases of the utilization of anthracite at its new laboratory at Wilkes-Barre, Pa. (See details under Research.) Representatives of the institute appeared before various Government agencies in opposing the extension and infiltration of natural-gas lines into the anthracite markets. The Anthracite Institute Dealer Schools, suspended during the war, were resumed; subjects discussed included competitive fuels, draft and combustion, heating controls, air conditioning, merchandising, and public relations. The Anthracite Institute Weekly Bulletin presented ably, to the industry and public, discussions and comments on matters of interest to those concerned with anthracite.

A new era in the development of employer-employee relationship in the anthracite industry was ushered in with the inauguration of meetings of the supervisory forces of anthracite-producing companies and representatives of local offices of the United Mine Workers of America to discuss anthracite problems. The meetings were held at the institute building in Wilkes-Barre. Similarly, the formation of the Producer-Retailer Committee has promoted a closer in lustry marketing relationship between operators, wholesalers, and the coal merchants.

Anthracite Committee.—The Anthracite Committee, supported by producers representing a large percentage of the total anthracite output, kept the industry well informed on "bootleg" mining operations and compiled current data on production, employment, requirements, and other important phases of the industry. The standard anthracite size specifications issued by the committee, and effective January 14, 1946, are given in table 3 of the 1945 issue of this chapter.

Labor Relations.—Early in May 1946 the anthracite producers and the United Mine Workers of America convened to discuss a new wage agreement to supersede the one that was to expire at midnight May 30. An agreement was not reached on the expiration date, and in the absence of a contract the miners failed to report for work on May 31. A new contract was consummated on June 7, and all mine workers were directed to return to work on June 10.

The agreement represents a number of gains for the mine workers, among which were the following: Annual holidays were increased from six to eight, the additions being February 12 (Lincoln's birthday) and October 29th (Mitchell Day). Mitchell Day has been observed for a number of years, but previous contracts have not provided that it be a time and one-half holiday. In addition to the aforementioned holidays, January 1, May 30, July 4, Labor Day, Thanksgiving Day, and Christmas Day are recognized holidays, and when worked the employee shall be paid rate and one-half. Contract workers received an increase of $1.295 per start. Travel time for inside employees was increased from $1.132 for a 45-minute period to $1.339. Rates for strip-pit employees, outside men, inside company men, consideration miners, and laborers were increased 18½ cents per hour, or $1.295 for a 7-hour day. A health and welfare fund was provided by the assessment of 5 cents per ton on each ton of coal mined for sale or company use. In administering the fund the contract provides for three trustees, two of whom are to be appointed by the president of the United Mine Workers of America

and one by the operators. Vacation pay was increased from $75 to $100, with the 1946 vacation limited to 4 days, July 4 to 7, inclusive. The 6-day week agreement of voluntary work negotiated in January 1943 was rescinded; the basic work week is 7 hours 5 days a week, and the sixth day is a voluntary workday. The contract is an open one, and at any time after the date of execution either party may have the contract reopened by giving 10 days' written notice requesting a conference. At the end of 15 days, after the beginning of such negotiating conference, either party may give to the other notice in writing of termination of the agreement, to be effective 5 days after the receipt of such notice.

The anthracite industry, although not involved in the bituminous-coal strike of November 21–December 7, 1946, inclusive, did lose approximately 60,000 tons production in an unauthorized walk-out of 10,000 miners on November 21–22. The men thought that John L. Lewis, president of the United Mine Workers, had been jailed because of his dispute with the Government and, when this impression proved erroneous, returned to work.

Employment.—The pressing problem of employment in the anthracite industry, which began in 1942, was greatly relieved in 1946 when the average number of men employed totaled 78,145, compared with 72,842 men in 1945. These data do not include men working in "bootleg" holes; for employment in this type of mining see table 15. Statistics on employment in recognized operations are shown in tables 28 and 29.

Research.—The Anthracite Institute completed arrangements in 1946 for a research project that is expected to provide unprecedented facilities and personnel for experimentation with various phases of gasification, oxygenation, and pelletizing of small sizes of anthracite and anthracite fines. Plans are being made also to include pulverization and traveling-grate stokers in the scope of the program. This will be the first opportunity that research engineers have had for extended tests on a single grouping of these importantly interrelated subjects. Individually or in combination, the methods to be investigated will undoubtedly lead to improvement in utilization of anthracite fines and to upgrading of the small sizes of anthracite. The Anthratube, a new device employed to burn anthracite under an entirely new principle of combustion, was improved substantially. Great strides were made also in upgrading small anthracite fines by extrusion. Transactions of the Fifth Annual Anthracite Conference held at Lehigh University, Bethlehem, Pa., May 1947, give a detailed discussion of these subjects and other phases of anthracite research.

Investigative work, conducted by the Anthracite Flood Prevention Section of the Bureau of Mines, was directed toward obtaining data on anthracite reserves, subsidence and backfilling, underground water pools, barrier pillars, etc., that will aid in determining the ratio of flood-prevention costs to benefits and give economic justification for construction projects. Research and practical work on flood prevention are extremely important, as flood control is connected directly with the economic life of the anthracite industry.

Research on mechanical mining was continued by the Bureau. The principal objective is improved methods, thus reducing production costs. Several shearing and new-type mechanical-loading ma-

chines were brought from Germany and have been installed in various anthracite mines for experimentation, particularly in pitching seams. The expected erection of a Bureau of Mines research laboratory in the anthracite region in the near future would advance research greatly.

Research work at Pennsylvania State College, sponsored jointly by the Commonwealth of Pennsylvania and the Anthracite Institute, concerned itself chiefly with the gasification of anthracite, the preparation of activated carbon from anthracite, studies on the utilization of anthracite silt, and physical properties of anthracite under thermal shock. Work was continued on fundamentals of combustion with reference to the influence of mineral and volatile matter. The State College cooperated with various other organizations in connection with pelletizing anthracite fines.

Imports and Exports.—Exports of anthracite in 1946 reached an all-time high of 6,506,829 net tons, surpassing the previous record year (1917), when shipments from this country totaled 6,007,306 tons. From all indications, exports in 1947 will easily surpass those of 1946.

Shipments to Canada in 1946 totaled 4,513,637 tons and were greater than in any year since 1923. It is not generally realized that Canada is the anthracite industry's secondary market, and shipments to that country comprise approximately 7 percent of the total. In the 1945–46 coal year Toronto was exceeded only by New York City and Philadelphia in the quantity of anthracite received, and Montreal was the fourth largest consumer of anthracite in that coal year. During the same period, receipts of anthracite by Canada equaled shipments to Maine, Connecticut, New Hampshire, Rhode Island, Vermont, Delaware, Virginia, and the District of Columbia. The principal reasons for the increase in our exports to Canada are shortages of other space-heating fuels in that country, increased demand for fuels created by new housing, and the inability of Great Britain to export anthracite to Canada in quantities approaching its prewar levels. Before the war Great Britain shipped about 1,200,000 net tons of anthracite to Canada annually; in 1946, its total coal exports to that country were only 96,281 tons.

Exports of anthracite to Europe in 1946 were 1,927,845 tons, virtually all of which was Barley and smaller sizes. Shipments to Europe in 1947 should far exceed those of 1946. The heavy demand for anthracite in Europe is the result of the low production of coal in Great Britain and other European coal-producing countries compared with their prewar output. Details on imports and exports are given in tables 36 and 37.

OUTLOOK

The anthracite markets should readily absorb available supplies of anthracite in the 1947–48 coal year. In fact, it is quite probable that the over-all supply of anthracite will not be adequate to meet requirements, unless production during the latter part of the year shows a very substantial gain over that during the first part. It is true that many mines worked only 3, 4, or 5 days a week during the first part of the 1947–48 coal year because the markets would not absorb more production. This was due principally to the lack of buying by consumers who ordinarily purchase a substantial part

of their winter requirement of anthracite during the summer months. The efforts on the part of the industry to have these consumers purchase part of their winter requirements during the nonheating season should tend to alleviate acute demands during the winter months. Although large quantities of anthracite are being exported to Europe, most of this coal is the smaller sizes, and if it were not exported it would not be mined and thus would not add to our available supply. A number of factors account for the heavy potential demand for anthracite: (1) Large exports both to Canada and to European countries, (2) additional anthracite required in new housing, (3) the occupation and need for fuel to heat many houses that were vacant prior to the war, (4) high purchasing power of consumers, and (5) withdrawal of coke from the domestic market. To retain its markets subsequent to 1947–48 the industry will be obliged to work closely with builders, architects, and heating-equipment manufacturers to obtain a fair share of the fuel business created by the millions of new homes that will be built during the next 10 years; the installation of automatic coal-burning equipment for both home and industrial purposes will be encouraged; concentrated merchandising programs, the search for new markets, and research on new uses for anthracite and upgrading of fine sizes will be continued.

SOURCES AND ACKNOWLEDGMENTS

Final statistics of the Pennsylvania anthracite-mining industry are prepared from an annual canvass, by mail, of producers and shippers. About 98 percent of the tonnage is reported direct, and the remaining 2 percent is collected by personal visits or from reliable collateral evidence. The data on individual operations are furnished voluntarily by the producers and treated confidentially.

In assembling available detailed information, free use has been made of pertinent figures prepared by the Anthracite Institute, the Anthracite Committee, the Association of American Railroads, and the Pennsylvania Department of Mines; to all of these thanks are extended for their cordial and continued cooperation. Thanks are also due especially to the producers for reporting so promptly and so fully on their 1946 operations.

PRODUCTION

Production of Pennsylvania anthracite in 1946 totaled 60,506,873 net tons, compared with 54,933,909 tons in 1945. These statistics include deep-mined and strip-pit output, coal recovered from culm banks, anthracite purchased by the industry from "bootleggers," and river or creek coal recovered from the streams draining the anthracite fields. Also included is a small tonnage of semianthracite (107,089 tons in 1946) produced in Sullivan County. See tables 3 to 8 for production and shipments by fields, regions, sizes, and counties. Table 9 shows percentages, by regions, of various sizes in relation to total breaker product.

Before 1930 anthracite was produced only by companies who owned or leased the coal lands. During the depression in the early 1930's, unemployed miners commenced to mine anthracite in the Lehigh and Schuylkill regions from lands of the operating companies without per-

mission of the owners, transporting the coal to market by truck. Before 1941 this coal, generally referred to as "bootleg coal," was not included in the production statistics of the Pennsylvania anthracite industry by the Bureau of Mines. In 1941, however, the anthracite industry started to purchase run-of-mine coal from the so-called "bootleggers" for preparation and shipment to market. In 1946 these purchases totaled 352,112 net tons. As it has been ruled impractical to segregate the purchased anthracite from the output of the industry proper, it is included in the various production tables in the Minerals Yearbook chapters on Pennsylvania anthracite for 1941–46. As a result, the production statistics for the last 6 years are not exactly comparable with those of previous years. To compute the output per man per day for the anthracite industry, it was necessary to deduct the "bootleg" purchases from the total tonnage shipped by the recognized industry, because adequate data on man-days required to produce the "bootleg" coal are not available. Details on this procedure are discussed under Employment.

TABLE 3.—Pennsylvania anthracite produced, 1942–46, by fields, in net tons

[The figures of breaker product include a certain quantity of culm-bank coal, which amounted to 5,311,791 tons in 1946]

Field	1942	1943	1944	1945	1946
Eastern Middle:					
Breakers	5,717,908	6,140,224	5,905,623	[1] 5,005,245	5,057,619
Washeries	259,378	356,450	403,688	[1] 342,116	282,481
Dredges					
Total Eastern Middle	5,977,286	6,496,674	6,309,311	5,347,361	5,340,100
Western Middle:					
Breakers	13,122,774	12,577,769	12,721,704	11,540,524	13,040,147
Washeries	333,089	280,525	538,875	130,789	530,246
Dredges	466,339	442,608	385,137	308,976	362,423
Total Western Middle	13,922,202	13,300,902	13,645,716	11,980,289	13,932,816
Southern:					
Breakers	8,797,539	10,519,946	12,194,069	10,916,769	11,817,427
Washeries	1,326,087	1,486,803	2,091,473	1,373,578	1,386,125
Dredges	794,627	879,379	983,046	896,250	761,131
Total Southern	10,918,253	12,886,128	15,268,588	13,186,597	13,964,683
Northern:					
Breakers	29,269,471	[1] 27,417,425	27,794,639	[1] 23,503,306	26,227,918
Washeries	168,237	[1] 432,021	531,338	[1] 735,041	925,427
Dredges	24,067	12,750	4,554		8,840
Total Northern	29,461,775	27,862,196	28,330,531	24,238,347	27,162,185
Total, excluding Sullivan County:					
Breakers	56,907,692	[1] 56,655,364	58,616,035	[1] 50,965,844	56,143,111
Washeries	2,086,791	[1] 2,555,799	3,565,374	[1] 2,581,524	3,124,279
Dredges	1,285,033	1,334,737	1,372,737	1,205,226	1,132,394
Total, excluding Sullivan County	60,279,516	60,545,900	63,554,146	54,752,594	60,399,784
Sullivan County:					
Breakers	48,213	97,720	147,217	149,505	85,402
Washeries				31,810	21,687
Total Sullivan County	48,213	97,720	147,217	181,315	107,089
Grand total	60,327,729	60,643,620	63,701,363	54,933,909	60,506,873

[1] Small quantity of washery coal included with breaker.

TABLE 4.—Pennsylvania anthracite shipped, sold locally, and used as colliery fuel in 1946, by regions

Region	Shipments		Local sales		Colliery fuel		Total	
	Net tons	Value [1]	Net tons	Value	Net tons	Value	Net tons	Value
Lehigh:								
Breakers	9,296,368	$63,492,959	558,991	$4,631,136	289,732	$1,222,600	10,145,091	$69,346,695
Washeries	349,543	1,483,468	19,582	133,855	750	2,760	369,875	1,620,083
Dredges	37,441	66,311					37,441	66,311
Total Lehigh	9,683,352	65,042,738	578,573	4,764,991	290,482	1,225,360	10,552,407	71,033,089
Schuylkill:								
Breakers	18,396,904	124,810,113	1,120,708	8,369,373	252,490	589,511	19,770,102	133,768,997
Washeries	1,826,036	7,642,475	1,509	6,921	1,432	3,430	1,828,977	7,652,826
Dredges	840,358	1,552,237	240,457	445,064	5,298	10,032	1,086,113	2,007,333
Total Schuylkill	21,063,298	134,004,825	1,362,674	8,821,358	259,220	602,973	22,685,192	143,429,156
Wyoming:								
Breakers	22,368,877	174,594,487	2,455,668	17,684,004	1,403,373	3,172,709	26,227,918	195,451,200
Washeries	909,270	2,784,268	7,032	13,927	9,125	16,897	925,427	2,815,092
Dredges	8,840	17,680					8,840	17,680
Total Wyoming	23,286,987	177,396,435	2,462,700	17,697,931	1,412,498	3,189,606	27,162,185	198,283,972
Total, excluding Sullivan County:								
Breakers	50,062,149	362,897,559	4,135,367	30,684,513	1,945,595	4,984,820	56,143,111	398,566,892
Washeries	3,084,849	11,910,211	28,123	154,703	11,307	23,087	3,124,279	12,088,001
Dredges	886,639	1,636,228	240,457	445,064	5,298	10,032	1,132,394	2,091,324
Total	54,033,637	376,443,998	4,403,947	31,284,280	1,962,200	5,017,939	60,399,784	412,746,217
Sullivan County: [2]								
Breakers	53,278	330,424	31,574	203,175	550	3,177	85,402	536,776
Washeries	21,672	133,982	15	95			21,687	134,077
Total Sullivan County	74,950	464,406	31,589	203,270	550	3,177	107,089	670,853
Grand total:								
1946	54,108,587	376,908,404	4,435,536	31,487,550	1,962,750	5,021,116	60,506,873	413,417,070
1945	48,542,451	293,921,884	4,273,864	25,639,359	2,117,594	4,383,192	54,933,909	323,944,435
Change, 1946-percent	+11.5	+28.2	+3.8	+22.8	−7.3	+14.6	+10.1	+27.6

[1] Value given for shipments is value at which coal left possession of producing company and does not include margins of separately incorporated sales companies.

[2] For purposes of historical comparison and statistical convenience, the mines of Sullivan County are grouped with the Pennsylvania anthracite region, although the product is classified as semianthracite according to the American Society for Testing Materials Tentative Standard.

TABLE 5.—Pennsylvania anthracite produced in 1946, classified as fresh-mined, culm-bank, and river coal, and as breaker, washery, and dredge product, by regions, in net tons

Region and type of plant	From mines			From culm banks	From river dredging	Total
	Underground		Strip pits			
	Mechanically loaded	Hand-loaded				
Lehigh:						
Breakers	730,509	5,597,430	2,311,437	1,505,715		10,145,091
Washeries				369,875		369,875
Dredges					37,441	37,441
Total Lehigh	730,509	5,597,430	2,311,437	1,875,590	37,441	10,552,407
Schuylkill:						
Breakers	1,891,772	7,039,045	7,889,456	2,949,829		19,770,102
Washeries		12,115	14,550	1,802,312		1,828,977
Dredges					1,086,113	1,086,113
Total Schuylkill	1,891,772	7,051,160	7,904,006	4,752,141	1,086,113	22,685,192
Wyoming:						
Breakers	12,996,881	9,754,191	2,621,399	855,447		26,227,918
Washeries				925,427		925,427
Dredges					8,840	8,840
Total Wyoming	12,996,881	9,754,191	2,621,399	1,780,874	8,840	27,162,185
Total, excluding Sullivan County:						
Breakers	15,619,162	22,390,666	12,822,292	5,310,991		56,143,111
Washeries		12,115	14,550	3,097,614		3,124,279
Dredges					1,132,394	1,132,394
Total	15,619,162	22,402,781	12,836,842	8,408,605	1,132,394	60,399,784
Sullivan County:						
Breakers		62,514	22,088	800		85,402
Washeries				21,687		21,687
Total Sullivan County		62,514	22,088	22,487		107,089
Grand total	15,619,162	22,465,295	12,858,930	8,431,092	1,132,394	60,506,873

TABLE 6.—Pennsylvania anthracite produced in 1946, classified as fresh-mined, culm-bank, and river coal, and as breaker, washery, and dredge product, by fields, in net tons

Field and type of plant	From mines			From culm bank	From river dredging	Total
	Underground		Strip pits			
	Mechanically loaded	Hand-loaded				
Eastern Middle:						
Breakers	730,509	2,474,572	1,144,526	708,012	----------	5,057,619
Washeries	----------	----------	----------	282,481	----------	282,481
Total Eastern Middle	730,509	2,474,572	1,144,526	990,493	----------	5,340,100
Western Middle:						
Breakers	1,521,472	5,382,582	4,233,724	1,902,369	----------	13,040,147
Washeries	----------	----------	10,187	520,059	----------	530,246
Dredges	----------	----------	----------	----------	362,423	362,423
Total Western Middle	1,521,472	5,382,582	4,243,911	2,422,428	362,423	13,932,816
Southern:						
Breakers	370,300	4,779,321	4,822,643	1,845,163	----------	11,817,427
Washeries	----------	12,115	4,363	1,369,647	----------	1,386,125
Dredges	----------	----------	----------	----------	761,131	761,131
Total Southern	370,300	4,791,436	4,827,006	3,214,810	761,131	13,964,683
Northern:						
Breakers	12,996,881	9,754,191	2,621,399	855,447	----------	26,227,918
Washeries	----------	----------	----------	925,427	----------	925,427
Dredges	----------	----------	----------	----------	8,840	8,840
Total Northern	12,996,881	9,754,191	2,621,399	1,780,874	8,840	27,162,185
Total, excluding Sullivan County:						
Breakers	15,619,162	22,390,666	12,822,292	5,310,991	----------	56,143,111
Washeries	----------	12,115	14,550	3,097,614	----------	3,124,279
Dredges	----------	----------	----------	----------	1,132,394	1,132,394
Total	15,619,162	22,402,781	12,836,842	8,408,605	1,132,394	60,399,784
Sullivan County:						
Breakers	----------	62,514	22,088	800	----------	85,402
Washeries	----------	----------	----------	21,687	----------	21,687
Total Sullivan County	----------	62,514	22,088	22,487	----------	107,089
Grand total	15,619,162	22,465,295	12,858,930	8,431,092	1,132,394	60,506,873

TABLE 7.—Pennsylvania anthracite shipped in 1946, by regions and sizes

Size	Breaker shipments [1]						Washery shipments		Dredge shipments	Grand total
	Lehigh region	Schuylkill region	Wyoming region	Sullivan County	Total		Excluding Sullivan County	Including Sullivan County		
					Excluding Sullivan County	Including Sullivan County				
NET TONS										
Lump [2] and Broken	57,396	22,231	45,041	----------	124,668	124,668	----------	----------	----------	124,668
Egg	605,396	945,550	1,620,295	----------	3,171,241	3,171,241	----------	----------	----------	3,171,241
Stove	1,787,483	3,146,182	6,092,375	10,085	11,026,040	11,036,125	142,005	142,005	----------	11,178,130
Chestnut	1,993,451	4,177,310	6,716,715	11,071	12,887,476	12,898,547	360,324	373,959	----------	13,272,506
Pea	758,193	1,514,317	1,443,212	6,566	3,715,722	3,722,288	134,733	138,364	605	3,861,257
Total domestic	5,201,919	9,805,590	15,917,638	27,722	30,925,147	30,952,869	637,062	654,328	605	31,607,802
Buckwheat No. 1	1,272,775	2,766,188	2,899,732	8,755	6,938,695	6,947,450	223,665	226,736	7,657	7,181,843
Buckwheat No. 2 (Rice)	854,857	1,569,313	1,458,663	16,086	3,882,833	3,898,919	187,835	189,170	40,319	4,128,408
Buckwheat No. 3 (Barley)	972,236	2,553,220	1,405,719	----------	4,931,175	4,931,175	425,474	425,474	164,304	5,520,953
Buckwheat No. 4	308,085	1,246,366	466,326	----------	2,020,777	2,020,777	1,018,237	1,018,237	276,515	3,315,529
Other (including silt)	686,496	456,227	220,799	715	1,363,522	1,364,237	592,576	592,576	397,239	2,354,052
Total steam	4,094,449	8,591,314	6,451,239	25,556	19,137,002	19,162,558	2,447,787	2,452,193	886,034	22,500,785
Grand total	9,296,368	18,396,904	22,368,877	53,278	50,062,149	50,115,427	3,084,849	3,106,521	886,639	54,108,587
VALUE										
Lump [2] and Broken	$524,667	$209,534	$416,944	----------	$1,151,145	$1,151,145	----------	----------	----------	$1,151,145
Egg	5,644,521	8,966,133	15,124,045	----------	29,734,699	29,734,699	----------	----------	----------	29,734,699
Stove	16,837,837	29,957,468	56,848,821	$92,678	103,644,126	103,736,804	$1,277,716	$1,277,716	----------	105,014,520
Chestnut	18,730,785	39,860,499	62,753,973	101,097	121,345,257	121,446,354	3,245,457	3,344,255	----------	124,790,609
Pea	5,851,058	11,944,370	11,166,485	52,167	28,961,913	29,014,080	990,330	1,012,939	$3,647	30,030,666
Total domestic	47,588,868	90,938,004	146,310,268	245,942	284,837,140	285,083,082	5,513,503	5,634,910	3,647	290,721,639
Buckwheat No. 1	7,019,078	15,351,779	15,973,061	41,107	38,343,918	38,385,025	1,170,084	1,181,341	40,820	39,607,186
Buckwheat No. 2 (Rice)	3,847,605	7,126,069	6,593,939	42,124	17,567,613	17,609,737	771,668	772,986	108,355	18,491,078
Buckwheat No. 3 (Barley)	3,004,433	7,894,554	4,445,228	----------	15,344,215	15,344,215	1,251,318	1,251,318	341,513	16,937,046
Buckwheat No. 4	695,041	2,662,840	860,974	----------	4,218,855	4,218,855	2,121,111	2,121,111	480,615	6,820,581
Other (including silt)	1,337,934	836,867	411,017	1,251	2,585,818	2,587,069	1,082,527	1,082,527	661,278	4,330,874
Total steam	15,904,091	33,872,109	28,284,219	84,482	78,060,419	78,144,901	6,396,708	6,409,283	1,632,581	86,186,765
Grand total	63,492,959	124,810,113	174,594,487	330,424	362,897,559	363,227,983	11,910,211	12,044,193	1,636,228	376,908,404

See footnotes at end of table.

TABLE 7.—Pennsylvania anthracite shipped in 1946, by regions and sizes—Continued

Size	Breaker shipments [1]						Washery shipments		Dredge shipments	Grand total
	Lehigh region	Schuylkill region	Wyoming region	Sullivan County	Total		Excluding Sullivan County	Including Sullivan County		
					Excluding Sullivan County	Including Sullivan County				
AVERAGE VALUE PER TON										
Lump [2] and Broken	$9.14	$9.43	$9.26		$9.23	$9.23				$9.23
Egg	9.32	9.48	9.33		9.38	9.38				9.38
Stove	9.42	9.52	9.33	$9.19	9.40	9.40	$9.00	$9.00		9.39
Chestnut	9.40	9.54	9.34	9.13	9.42	9.42	9.01	8.94		9.40
Pea	7.72	7.89	7.74	7.95	7.79	7.79	7.35	7.32	$6.03	7.78
Total domestic	9.15	9.27	9.19	8.87	9.21	9.21	8.65	8.61	6.03	9.20
Buckwheat No. 1	5.51	5.55	5.51	4.70	5.53	5.53	5.23	5.21	5.33	5.51
Buckwheat No. 2 (Rice)	4.50	4.54	4.52	2.62	4.52	4.52	4.11	4.09	2.69	4.48
Buckwheat No. 3 (Barley)	3.09	3.09	3.16		3.11	3.11	2.94	2.94	2.08	3.07
Buckwheat No. 4	2.26	2.14	1.85		2.09	2.09	2.08	2.08	1.74	2.06
Other (including silt)	1.95	1.83	1.86	1.75	1.90	1.90	1.83	1.83	1.66	1.84
Total steam	3.88	3.94	4.38	3.31	4.08	4.08	2.61	2.61	1.84	3.83
Grand total	6.83	6.78	7.81	6.20	7.25	7.25	3.86	3.88	1.85	6.97

[1] Figures of shipments from breakers include some culm-bank coal handled in breakers.
[2] Quantity of Lump included is insignificant.

TABLE 8.—Pennsylvania anthracite produced in 1946, by counties

County	Total shipments		Sold to local trade		Used for power and heat		Total production	
	Net tons	Value [1]	Net tons	Value	Net tons	Value	Net tons	Value
Berks, Lancaster, Lebanon, Northampton, and Snyder [2]	233,385	$416,621	9,940	$14,705	35	$240	243,360	$431,566
Carbon	3,706,707	24,883,256	215,713	1,905,520	89,575	421,265	4,011,995	27,210,041
Columbia	1,272,016	9,526,302	69,049	388,024	52,752	114,225	1,393,817	10,028,551
Dauphin	99,106	379,295	174,728	327,876	1,651	5,436	275,485	712,607
Lackawanna	7,342,424	52,865,498	1,074,451	8,107,452	342,347	981,495	8,759,222	61,954,445
Luzerne	19,238,980	148,862,376	1,667,723	11,833,079	1,220,347	2,740,167	22,127,050	163,435,622
Northumberland	5,758,847	34,617,030	472,479	3,339,248	34,894	69,364	6,266,220	38,025,642
Schuylkill	16,208,200	104,180,634	717,239	5,346,114	211,040	667,413	17,136,479	110,194,161
Sullivan	74,950	464,406	31,589	203,270	550	3,177	107,089	670,853
Susquehanna and Wayne	173,972	712,986	2,625	22,262	9,559	18,334	186,156	753,582
Total	54,108,587	376,908,404	4,435,536	31,487,550	1,962,750	5,021,116	60,506,873	413,417,070

[1] Value given for shipments is value at which coal left possession of producing company and does not include margins of separately incorporated sales companies.
[2] Counties producing dredge coal only.

TABLE 9.—Sizes of Pennsylvania anthracite shipped from breakers, 1944–46, by regions, in percent of total

[Note that shipments of dredge and washery coal are not included]

Size	Percent of total shipments								
	Lehigh region			Schuylkill region			Wyoming region		
	1944	1945	1946	1944	1945	1946	1944	1945	1946
Lump [1] and Broken	0.5	0.6	0.6	0.1	0.1	0.1	0.5	0.2	0.2
Egg	6.0	5.8	6.5	6.2	5.9	5.2	8.3	7.4	7.3
Stove	19.2	19.3	19.2	17.0	16.1	17.1	26.9	27.6	27.2
Chestnut	22.1	22.1	21.5	21.8	21.8	22.7	29.1	30.2	30.0
Pea	9.3	8.9	8.2	9.3	8.9	8.2	6.9	6.3	6.5
Total domestic	57.1	56.7	56.0	54.4	52.8	53.3	71.7	71.7	71.2
Buckwheat No. 1	14.3	13.6	13.7	15.4	15.4	15.0	13.3	13.3	12.9
Buckwheat No. 2 (Rice)	9.6	9.2	9.2	10.0	9.5	8.5	6.8	6.4	6.5
Buckwheat No. 3 (Barley)	11.1	9.9	10.4	13.4	14.3	13.9	6.4	6.4	6.3
Buckwheat No. 4	2.5	3.5	3.3	5.7	6.5	6.8	1.3	1.4	2.1
Other (including silt)	5.4	7.1	7.4	1.1	1.5	2.5	.5	.8	1.0
Total steam	42.9	43.3	44.0	45.6	47.2	46.7	28.3	28.3	28.8

Size	Sullivan County			Total					
				Excluding Sullivan County			Including Sullivan County		
Lump [1] and Broken	------	------	------	0.4	0.3	0.3	0.3	0.3	0.3
Egg	------	------	------	7.1	6.5	6.3	7.1	6.5	6.3
Stove	14.5	25.3	18.9	21.9	21.7	22.0	21.9	21.7	22.0
Chestnut	26.4	28.4	20.8	25.2	25.5	25.8	25.2	25.5	25.8
Pea	22.1	12.7	12.3	8.2	7.8	7.4	8.3	7.8	7.4
Total domestic	63.0	66.4	52.0	62.8	61.8	61.8	62.8	61.8	61.8
Buckwheat No. 1	12.5	13.0	16.4	14.3	14.1	13.9	14.2	14.1	13.9
Buckwheat No. 2 (Rice)	1.6	2.3	30.2	8.5	8.1	7.8	8.5	8.1	7.8
Buckwheat No. 3 (Barley)	------	------	------	9.7	10.0	9.8	9.7	9.9	9.8
Buckwheat No. 4	22.9	------	------	3.0	3.6	4.0	3.1	3.6	4.0
Other (including silt)	------	18.3	1.4	1.7	2.4	2.7	1.7	2.5	2.7
Total steam	37.0	33.6	48.0	37.2	38.2	38.2	37.2	38.2	38.2

[1] Quantity of Lump included is insignificant.

By Weeks and Months.—Tables 10 and 11 summarize statistics of weekly and monthly production, estimated from records of carloadings and from tonnage reports from trade sources. The weekly and monthly figures have been adjusted to the annual total ascertained by direct canvass of the operators.

TABLE 10.—Estimated weekly production of Pennsylvania anthracite in 1946

Week ended—	Net tons	Week ended—	Net tons
Jan. 5	[1] 595,000	July 20	1,336,000
12	1,210,000	27	1,301,000
19	1,127,000	Aug. 3	1,209,000
26	1,210,000	10	1,252,000
Feb. 2	1,243,000	17	1,086,000
9	1,162,000	24	1,269,000
16	1,232,000	31	1,274,000
23	1,134,000	Sept. 7	1,029,000
Mar. 2	1,235,000	14	1,251,000
9	1,195,000	21	1,276,000
16	1,272,000	28	1,260,000
23	1,297,000	Oct. 5	1,246,000
30	1,306,000	12	1,192,000
Apr. 6	1,058,000	19	1,199,000
13	1,335,000	26	1,292,000
20	1,097,000	Nov. 2	846,000
27	1,110,000	9	1,270,000
May 4	1,405,000	16	1,193,000
11	1,439,000	23	1,187,000
18	1,333,000	30	1,160,000
25	1,011,000	Dec. 7	1,251,000
June 1	747,000	14	1,347,000
8	46,000	21	1,272,000
15	1,116,000	28	818,000
22	1,193,000	31	[1] 377,000
29	1,257,000		
July 6	664,000	Calendar year	60,507,000
13	1,285,000		

[1] Figures represent output of working days in that part of week included in the calendar year 1946. Preliminary production for week of January 4, 1947, was 881,000 tons. Revised total for week of January 5, 1946, was 735,000 tons.

TABLE 11.—Estimated monthly production of Pennsylvania anthracite, 1939–46, in thousands of net tons [1]

Month	1939	1940	1941	1942	1943	1944	1945	1946
January	5,019	5,783	5,162	4,560	4,466	4,970	4,219	4,968
February	4,169	3,648	4,596	4,801	5,203	5,811	4,471	4,774
March	3,652	3,881	4,765	5,116	5,855	5,512	5,269	5,476
April	5,367	3,853	3,317	5,185	5,337	5,141	5,124	5,069
May	5,141	4,070	4,001	4,873	5,219	5,781	2,083	5,453
June	3,577	4,492	5,072	5,153	3,244	5,558	5,667	3,625
July	2,951	4,534	4,855	5,374	5,698	4,905	4,944	5,248
August	3,883	3,883	5,441	5,212	5,653	5,558	4,656	5,428
September	4,840	4,172	5,334	5,459	5,474	5,380	4,640	5,033
October	4,985	4,355	5,580	5,132	5,359	5,538	5,304	5,393
November	3,989	3,980	3,974	4,824	4,140	5,029	4,559	4,975
December	3,914	4,834	4,271	4,639	4,996	4,518	3,998	5,065
	51,487	51,485	56,368	60,328	60,644	63,701	54,934	60,507

[1] Production is estimated from weekly carloadings as reported by the Association of American Railroads and includes mine fuel, coal sold locally, and dredge coal. Includes in 1941–46 some "bootleg" coal purchased by legitimate operators and prepared at their breakers.

TABLE 12.—Culm-bank coal put through breakers, 1942–46, by fields, in net tons

Year	Northern	Eastern Middle	Western Middle	Southern	Total
1942	291,136	420,150	1,413,398	523,589	2,648,273
1943	[1] [2] 629,713	1,087,648	2,102,124	1,208,414	[1] 5,027,899
1944	[2] 1,156,489	743,867	2,528,221	1,699,875	6,128,452
1945	[1] [2] 996,037	[1] 698,876	2,335,200	2,206,187	[1] 6,236,300
1946	[2] 856,247	708,012	1,902,369	1,845,163	5,311,791

[1] Includes some washery coal.
[2] A small quantity of culm-bank coal was put through breakers in Sullivan County.

TABLE 13.—Statistical trends in the Pennsylvania anthracite industry, 1890–1946

Year	Production (net tons)	Value of production	Average value per net ton	Exports (net tons)[1]	Imports (net tons) (1)	Apparent consumption (net tons)[2]	Average number of employees	Average number of days worked	Average tons per man per day	Average tons per man per year	Quantity cut by machines (net tons)[3]	Quantity produced by stripping (net tons)[4]	Quantity loaded mechanically underground (net tons)[5]
1890	46,468,641	$66,383,772	$1.43	889,655	16,962	45,596,000	126,000	200	1.85	369			
1891	50,665,431	73,944,735	1.46	964,601	42,120	49,743,000	126,350	203	1.98	401			
1892	52,472,504	82,442,000	1.57	953,836	72,865	51,592,000	129,050	198	2.06	407			
1893	53,967,543	85,687,078	1.59	1,493,281	60,220	52,534,000	132,944	197	2.06	406			
1894	51,921,121	78,488,063	1.51	1,613,500	100,876	50,408,000	131,603	190	2.08	395			
1895	57,999,337	82,019,272	1.41	1,647,195	158,297	56,510,000	142,917	196	2.07	406			
1896	54,346,081	81,748,651	1.50	1,512,000	113,892	52,948,000	148,991	174	2.10	365			
1897	52,611,681	79,301,954	1.51	1,454,620	27,478	51,185,000	149,884	150	2.34	351			
1898	53,382,645	75,414,537	1.41	1,513,062	3,527	51,873,000	145,504	152	2.41	367			
1899	60,418,005	88,142,130	1.46	1,912,732	68	58,505,000	139,608	173	2.50	433			
1900	57,367,915	85,757,851	1.49	1,853,163	132	55,515,000	144,206	166	2.40	398			
1901	67,471,667	112,504,020	1.67	2,232,504	320	65,239,000	145,309	196	2.37	464			
1902	41,373,595	76,173,586	1.84	1,016,934	190,636	40,547,000	148,141	116	2.40	279			
1903	74,607,068	152,036,448	2.04	2,249,920	196,837	72,554,000	150,483	206	2.41	496			
1904	73,156,709	138,974,020	1.90	2,495,799	81,232	70,742,000	155,861	200	2.35	469			
1905	77,659,850	141,879,000	1.83	2,497,581	38,350	75,201,000	165,406	215	2.18	470			
1906	71,282,411	131,917,694	1.85	2,483,005	36,236	68,836,000	162,355	195	2.25	439			
1907	85,604,312	163,584,056	1.91	3,021,841	11,085	82,594,000	167,234	220	2.33	512			
1908	83,268,754	158,178,849	1.90	3,082,641	18,462	80,205,000	174,174	200	2.39	478			
1909	81,070,359	149,181,587	1.84	3,183,840	3,574	77,890,000	[6] 171,195	205	(7)	(7)			
1910	84,485,236	160,275,302	1.90	3,384,222	9,180	81,110,000	169,497	229	2.17	498			
1911	90,464,067	175,189,392	1.94	3,980,479	2,759	86,486,000	172,585	246	2.13	524	69,907		
1912	84,361,598	177,622,626	2.11	4,131,444	1,870	80,232,000	174,030	231	2.10	485	246,216		
1913	91,524,922	195,181,127	2.13	4,652,912	1,004	85,474,000	175,745	257	2.02	520	555,776		
1914	90,821,507	188,181,399	2.07	4,289,873	17,696	84,041,000	179,679	245	2.06	505	916,596		
1915	88,995,061	184,653,498	2.07	3,965,255	814	88,144,000	176,552	230	2.19	504	1,307,756	1,121,603	
1916	87,578,493	202,009,561	2.31	4,665,530	6,000	87,118,000	159,869	253	2.16	548	1,839,506	1,987,800	
1917	99,611,811	283,650,723	2.85	6,007,306	13,000	94,068,000	154,174	285	2.27	646	1,955,223	2,301,588	
1918	98,826,084	336,480,347	3.40	4,967,808	37,272	92,775,000	147,121	293	2.29	672	1,857,514	2,360,183	
1919	88,092,201	364,926,950	4.14	4,976,598	82,818	81,518,000	154,571	266	2.14	570	1,575,205	2,006,879	
1920	89,598,249	434,252,198	4.85	5,403,749	31,748	85,786,000	145,074	271	2.28	618	938,073	2,054,441	
1921	90,473,451	452,304,903	5.00	4,677,368	8,894	81,950,000	159,499	271	2.09	567	979,145	2,027,790	
1922	54,683,022	273,700,125	5.01	2,649,457	233,528	56,799,000	156,849	151	2.31	349	502,793	949,745	
1923	93,339,009	506,786,768	5.43	5,090,138	300,360	86,914,000	157,743	268	2.21	592	1,208,542	2,263,098	
1924	87,926,862	477,230,852	5.43	4,017,785	117,951	80,717,000	160,009	274	2.00	550	1,423,884	1,865,677	
1925	61,817,149	327,664,512	5.30	3,179,006	382,894	64,061,000	160,312	182	2.12	386	941,189	1,578,478	
1926	84,437,452	474,164,252	5.62	4,029,683	813,956	77,221,000	165,386	244	2.09	511	931,650	2,401,356	
1927	80,095,564	420,941,726	5.26	3,325,507	119,030	74,672,000	165,259	225	2.15	485	1,171,888	2,153,156	[6] 2,223,281
1928	75,348,069	393,637,690	5.22	3,336,272	384,707	73,650,000	160,681	217	2.17	469	1,289,809	2,422,924	[6] 2,351,074
1929	73,828,195	385,642,751	5.22	3,406,369	487,172	71,457,000	151,501	225	2.16	487	1,159,910	1,911,766	3,470,158

1930	69,384,837	354,574,191	5.11	2,551,659	674,812	67,628,000	150,804	208	2.21	460	1,410,123	2,536,288	4,467,750
1931	59,645,652	296,354,586	4.97	1,778,308	637,951	58,408,000	139,431	181	2.37	428	1,587,265	3,813,237	4,384,780
1932	49,855,221	222,375,129	4.46	1,303,355	607,097	50,500,000	121,243	162	2.54	411	1,674,223	3,980,973	5,433,340
1933	49,541,344	206,718,405	4.17	1,034,562	456,252	49,600,000	104,633	182	2.60	473	1,648,249	4,932,069	6,557,267
1934	57,168,291	244,152,245	4.27	1,297,610	478,118	55,500,000	109,050	207	2.53	524	1,981,088	5,798,138	9,284,486
1935	52,158,783	210,130,565	4.03	1,608,549	571,439	51,100,000	103,269	189	2.68	505	1,848,095	5,187,072	9,279,057
1936	54,579,535	227,003,538	4.16	1,678,024	614,639	53,200,000	102,081	192	2.79	535	2,162,744	6,203,267	10,827,946
1937	51,856,433	197,598,849	3.81	1,914,173	395,737	50,400,000	99,085	189	2.77	523	1,984,512	5,696,018	10,683,837
1938	46,099,027	180,600,167	3.92	1,908,911	362,895	45,200,000	96,417	171	2.79	478	1,588,407	5,095,341	10,151,669
1939	51,487,377	187,175,324	3.64	2,590,000	298,153	49,700,000	93,138	183	3.02	553	1,881,884	5,486,479	11,773,833
1940	51,484,640	205,489,814	3.99	2,667,632	135,436	49,000,000	91,313	186	3.02	562	1,816,483	6,352,700	12,326,000
1941	[8] 56,368,267	240,275,126	4.26	3,380,189	74,669	52,700,000	88,054	203	[9] 3.04	617	1,855,422	7,316,574	13,441,987
1942	[8] 60,327,729	271,673,380	4.50	4,438,588	140,115	56,500,000	82,121	239	[9] 2.95	705	2,285,640	9,070,933	14,741,459
1943	[8] 60,643,620	306,816,018	5.06	4,138,680	166,020	57,100,000	79,153	270	[9] 2.78	751	1,624,883	8,989,387	14,745,793
1944	[8] 63,701,363	354,582,884	5.57	4,185,933	11,847	59,400,000	77,591	292	[9] 2.79	815	1,336,082	10,953,030	14,975,146
1945	[8] 54,933,909	323,944,435	5.90	3,691,247	149	51,600,000	72,842	269	[9] 2.79	751	1,210,171	10,056,325	13,927,955
1946	[8] 60,506,873	413,417,070	6.83	6,506,829	9,556	53,900,000	78,145	271	[9] 2.84	770	1,232,828	12,858,930	15,619,162

[1] U. S. Department of Commerce.
[2] Prior to 1913 the figures of consumption take no account of producers' stocks, there being no data available for this item.
[3] Data first collected in 1911.
[4] Data first collected in 1915.
[5] Data first collected in 1929.
[6] As reported by the Commonwealth of Pennsylvania, Department of Mines.
[7] Data not available.
[8] Includes some "bootleg" coal purchased by legitimate operators and prepared at their breakers.
[9] Output per man per day calculated on legitimate tonnages only; "bootleg" purchases excluded.

Culm-Bank Coal.—The recovery of 8,431,092 tons of anthracite from culm banks in 1946 was a decline of 12 and 4 percent from the output of coal from this source in 1944 and 1945, respectively. With the urgent demand for coal during the war years, culm-bank production increased substantially, and even the 1946 tonnage was a large gain over prewar years. Much of the coal recovered from the culm banks is the smaller sizes of anthracite, and although output from this source may hold at a relatively high figure for a number of years, the quantity of anthracite recoverable from culm banks is limited. Tables 5, 6, and 12, give details on culm-bank output.

Historical Statistics.—Pertinent historical data on the Pennsylvania anthracite industry, 1890–1946, are given in table 13.

"Bootleg" Coal.—A survey by the Anthracite Committee in March 1947 revealed that 863 "bootleg" holes were being worked by 2,817 men, a substantial increase from 1,939 men working 526 holes disclosed by the committee's survey of March 1946. The production of "bootleg" coal was 1,448,529 net tons compared with 1,026,000 tons in 1945. The record production from this type of mining was 6,300,000 tons in 1941. Statistical details on "bootleg" mining for 1941–46 are given in tables 14 and 15.

TABLE 14.—Production, purchases by recognized operators, and fatalities at "bootleg" operations in the Pennsylvania anthracite industry, 1941–46

Year	Production (net tons) [1]	Purchased for preparation by recognized operations (net tons) [2]	Number of fatalities [1]	Year	Production (net tons) [1]	Purchased for preparation by recognized operations (net tons) [2]	Number of fatalities [1]
1941	6,300,000	1,902,481	61	1944	1,332,957	506,842	21
1942	3,931,000	2,616,839	45	1945	1,026,000	260,342	16
1943	1,912,467	1,265,617	22	1946	1,448,529	352,112	19

[1] Anthracite Committee, Harrisburg, Pa.
[2] As reported to Federal Bureau of Mines.

TABLE 15.—Number of men employed in "bootleg" operations in the Pennsylvania anthracite industry, 1941–46

[Anthracite Committee, Harrisburg, Pa.]

Date of survey	Number of "bootleg" operations	Average number of men employed	Date of survey	Number of "bootleg" operations	Average number of men employed
Mar. 31, 1941	3,006	10,762	Mar. 31, 1944	652	2,220
May 1, 1942	2,029	7,554	Mar. 7, 1945	502	1,806
Dec. 15, 1942	1,363	4,967	Mar. 30, 1946	526	1,939
Apr. 20, 1943	1,065	3,607	Mar. 31, 1947	863	2,817
Oct. 14, 1943	791	2,725			

VALUE OF SALES

During 1946 substantial wage increases were granted to the mine workers, and in order to meet the higher labor costs and other increased mining costs it was necessary for the producers to advance anthracite prices materially. Because of these increases the average sales realization per net ton on breaker shipments increased from $6.26 in 1945 to $7.25 in 1946. (See table 16.) With the inclusion of washery

coal, colliery fuel, local sales, and dredge coal the average value per ton of the total 1946 production is $6.83, compared with $5.90 in 1945. (See table 17.)

The average realization figures in this study represent value at the breaker, washery, or dredge reported by the operating companies. The company is requested to "estimate value of the product not sold" and to "exclude selling expenses" in making its report. From this it will be seen that, when a producing concern sells its output to a separately organized sales company, the value reported will exclude the margin of the sales company and may therefore be somewhat less than the circular price at which the coal is placed on the general market. This fact should be borne in mind in considering the variations in value among different regions for the same sizes of coal, as shown in the tables.

TABLE 16.—Average sales realization per net ton on Pennsylvania anthracite shipments from breakers, 1944–46, by regions and sizes

[Value does not include margins of separately incorporated sales companies]

Size	Lehigh region			Schuylkill region			Wyoming region		
	1944	1945	1946	1944	1945	1946	1944	1945	1946
Lump [1] and Broken	$7.40	$7.98	$9.14	$7.67	$8.17	$9.43	$7.46	$8.00	$9.26
Egg	7.58	8.10	9.32	7.58	8.18	9.48	7.54	8.11	9.33
Stove	7.61	8.11	9.42	7.62	8.18	9.52	7.54	8.07	9.33
Chestnut	7.61	8.09	9.40	7.64	8.20	9.54	7.54	8.09	9.34
Pea	6.16	6.56	7.72	6.16	6.66	7.89	6.02	6.60	7.74
Total domestic	7.37	7.86	9.15	7.37	7.93	9.27	7.39	7.95	9.19
Buckwheat No. 1	4.54	4.76	5.51	4.52	4.80	5.55	4.52	4.79	5.51
Buckwheat No. 2 (Rice)	3.65	3.87	4.50	3.51	3.89	4.54	3.65	3.95	4.52
Buckwheat No. 3 (Barley)	2.55	2.67	3.09	2.45	2.61	3.09	2.65	2.72	3.16
Buckwheat No. 4	1.94	2.02	2.26	1.77	1.81	2.14	1.87	1.82	1.85
Other (including silt)	1.43	1.62	1.95	1.23	1.48	1.83	1.45	1.48	1.86
Total steam	3.29	3.36	3.88	3.27	3.43	3.94	3.71	3.89	4.38
Total all sizes	5.62	5.91	6.83	5.50	5.81	6.78	6.35	6.80	7.81

Size	Sullivan County			Total—					
				Excluding Sullivan County			Including Sullivan County		
Lump [1] and Broken	------	------	------	$7.47	$8.02	$9.23	$7.47	$8.02	$9.23
Egg	------	------	------	7.56	8.13	9.38	7.56	8.13	9.38
Stove	$6.91	$7.41	$9.19	7.58	8.11	9.40	7.57	8.10	9.40
Chestnut	6.83	7.53	9.13	7.58	8.12	9.42	7.58	8.12	9.42
Pea	6.00	6.40	7.95	6.11	6.62	7.79	6.11	6.62	7.79
Total domestic	6.56	7.27	8.87	7.38	7.93	9.21	7.38	7.93	9.21
Buckwheat No. 1	4.01	4.08	4.70	4.52	4.79	5.53	4.52	4.79	5.53
Buckwheat No. 2 (Rice)	2.03	2.55	2.62	3.59	3.91	4.52	3.59	3.91	4.52
Buckwheat No. 3 (Barley)	------	------	------	2.53	2.65	3.11	2.53	2.65	3.11
Buckwheat No. 4	2.05	------	------	1.82	1.85	2.09	1.82	1.85	2.09
Other (including silt)	------	2.27	1.75	1.39	1.57	1.90	1.39	1.58	1.90
Total steam	2.71	2.99	3.31	3.42	3.56	4.08	3.42	3.56	4.08
Total all sizes	5.13	5.83	6.20	5.91	6.26	7.25	5.91	6.26	7.25

[1] Quantity of Lump included is insignificant.

TABLE 17.—Average value per ton of Pennsylvania anthracite shipments, local sales, colliery fuel, and total production, 1945–46, by regions [1]

[Values include washery and dredge coal]

Region	1945				1946			
	Shipments	Local sales	Colliery fuel	Total production	Shipments	Local sales	Colliery fuel	Total production
Lehigh	$5.84	$7.06	$3.15	$5.83	$6.72	$8.24	$4.22	$6.73
Schuylkill	5.52	4.74	2.14	5.42	6.36	6.47	2.33	6.32
Wyoming	6.65	6.41	1.85	6.33	7.62	7.19	2.26	7.30
Total, excluding Sullivan County	6.06	6.00	2.07	5.90	6.97	7.10	2.56	6.83
Sullivan County	5.56	5.90	2.92	5.63	6.20	6.43	5.78	6.26
Grand total	6.05	6.00	2.07	5.90	6.97	7.10	2.56	6.83

[1] Value given for shipments is value at which coal left possession of producing company and does not include margins of separately incorporated sales companies.

SHIPMENTS

The distribution data for the coal years 1944–45 and 1945–46 in tables 18 to 20 were compiled from reports submitted to the Bureau of Mines by producers and wholesalers of anthracite in the United States and Canada. The surveys for these 2 years were the third and fourth of a series, the first of which was for the 1942–43 coal year. The statistics in the first two surveys were used by the Solid Fuels Administration for War as an aid in its program for equitable distribution of anthracite and proved of such value to the anthracite industry that the Bureau was requested to continue the collection and publication of annual distribution data as a regular service.

As shown in table 19, 87 percent of the total shipments of anthracite to destinations in the United States and Canada were made to the New England and Middle Atlantic States. Shipments to Canada approximated 7 percent of the total distribution, while the Great Lakes region accounted for only 3 percent.

Data compiled from records of the Commonwealth of Pennsylvania Department of Mines show that anthracite shipments from the mines to destinations in the United States increased 8 percent in 1946 over 1945. Of the total United States shipments, 85 percent moved from the mines by rail and 15 percent by truck, whereas in 1945, 84 percent moved by rail and 16 percent by truck. Pennsylvania received 80 percent of the truck shipments in 1946; New Jersey and New York followed, with 9 percent each. Anthracite rail shipments, by destinations, for 1944–46 are shown in table 21 and truck movement in 1946, by months, and by States of destination, in table 22.

According to data compiled from records of the Massachusetts Division on the Necessaries of Life and the Anthracite Emergency Tidewater Bureau, rail receipts of Pennsylvania anthracite in New England increased 10 percent over 1945; tidewater receipts increased 20 percent. Details on anthracite movement to New England are given in table 23. Loadings at Lake Erie ports and receipts at the upper Lake docks each declined 10 percent from 1945. The substantial gain in Lake Erie loadings in 1944–46 over previous years is due largely to the increased use of the smaller steam sizes of anthracite by briquet manufacturers in the Great Lakes region.

TABLE 18.—Shipments of Pennsylvania anthracite, Apr. 1, 1944–Mar. 31, 1945, by States, Provinces, and countries of destination, in net tons

[As reported by producers and wholesalers on Solid Fuels Administration for War form SFA-26]

Destination	Domestic sizes						Steam sizes						Total all sizes	
	Broken	Egg	Stove	Chestnut	Pea	Total domestic sizes	Buckwheat No. 1	Buckwheat No. 2 (Rice)	Buckwheat No. 3 (Barley)	Buckwheat No. 4	All other sizes	Total steam sizes	Net tons	Percent of total
United States:														
New England States:														
Connecticut	548	82,520	514,365	562,952	79,478	1,239,863	114,217	67,450	50,616	463	218	232,964	1,472,827	2.54
Maine		38,559	160,989	146,285	13,916	359,749	26,673	11,073	1,169			38,915	398,664	.69
Massachusetts	1,225	446,614	1,158,266	830,690	83,383	2,520,178	157,654	112,223	80,858	10,552		361,287	2,881,465	4.97
New Hampshire		27,472	111,407	86,906	6,932	232,717	27,618	17,247	73,911	752		119,528	352,245	.61
Rhode Island		52,204	169,905	148,194	20,703	391,006	42,701	15,525	1,021			59,247	450,253	.78
Vermont	464	15,792	115,633	87,615	10,603	230,107	40,190	19,338	20,481			80,009	310,116	.53
Total	2,237	663,161	2,230,565	1,862,642	215,015	4,973,620	409,053	242,856	228,056	11,767	218	891,950	5,865,570	10.12
Middle Atlantic States:														
New Jersey	3,796	264,137	1,370,626	2,412,724	720,450	4,771,733	1,093,320	786,624	1,422,668	359,918	90,599	3,753,129	8,524,862	14.70
New York	25,641	1,515,622	4,187,942	4,015,293	1,473,492	11,217,990	4,258,411	1,766,972	1,317,612	162,376	266,263	7,771,634	18,989,624	32.76
Pennsylvania:														
Excluding "local sales"	43,706	277,919	1,243,330	2,493,742	1,238,360	5,297,057	980,794	1,094,330	1,877,311	1,138,671	330,591	5,421,697	10,718,754	18.49
"Local sales"	36,689	24,517	215,681	1,025,637	1,527,823	2,830,347	611,230	711,909	1,210,963	391,562	4,255	2,929,919	5,760,266	9.93
Total Pennsylvania	80,395	302,436	1,459,011	3,519,379	2,766,183	8,127,404	1,592,024	1,806,239	3,088,274	1,530,233	334,846	8,351,616	16,479,020	28.42
Total Middle Atlantic	109,832	2,082,195	7,017,579	9,947,396	4,960,125	24,117,127	6,943,755	4,359,835	5,828,554	2,052,527	691,708	19,876,379	43,993,506	75.88
South Atlantic States:														
Delaware	704	16,579	94,791	207,199	35,988	355,261	20,464	12,702	12,724	3,188		49,078	404,339	.70
District of Columbia	95	31,808	100,177	117,995	38,905	288,980	60,525	9,697	33,303			103,525	392,505	.68
Florida and Georgia		355	1,601	730		2,686		40				40	2,726	(1)
Maryland	1,335	87,669	320,937	322,834	81,131	813,906	140,889	16,309	99,254	4,967		261,419	1,075,325	1.85
North Carolina	31	47	1,080	1,692	126	2,976	107					107	3,083	.01
South Carolina		379	2,800	1,141		4,320	69					69	4,389	.01
Virginia		8,122	41,113	62,010	5,342	116,587	39,833	2,210	172	16,289		58,504	175,091	.30
West Virginia		96	362	748	39	1,245	36	11	73	24,087	9,997	34,204	35,449	.06
Total South Atlantic	2,165	145,055	562,861	714,349	161,531	1,585,961	261,923	40,969	145,526	48,531	9,997	506,946	2,092,907	3.61

See footnote at end of table.

TABLE 18.—Shipments of Pennsylvania anthracite, Apr. 1, 1944–Mar. 31, 1945, by States, Provinces, and countries of destination, in net tons—Continued

[As reported by producers and wholesalers on Solid Fuels Administration for War form SFA-26]

Destination	Domestic sizes						Steam sizes						Total all sizes	
	Broken	Egg	Stove	Chestnut	Pea	Total domestic sizes	Buckwheat No. 1	Buckwheat No. 2 (Rice)	Buckwheat No. 3 (Barley)	Buckwheat No. 4	All other sizes	Total steam sizes	Net tons	Percent of total
North Central States:														
Illinois	-------	7,105	38,636	182,962	6,109	234,812	1,542	35,799	6,747	6,175	74,041	124,304	359,116	0.62
Indiana	-------	1,512	2,650	91,590	114	95,866	223	2,414	2,398	39	89	5,163	101,029	.17
Iowa	-------	272	1,096	14,209	852	16,429	55	34	-------	-------	-------	89	16,518	.03
Kansas and Missouri	-------	1,252	804	4,456	111	6,623	-------	86	37	492	2,225	2,840	9,463	.02
Michigan	-------	8,935	81,177	133,630	1,342	225,084	5,832	8,898	-------	2,058	99,209	115,997	341,081	.59
Minnesota	-------	200	12,071	42,425	4,991	59,687	2,334	470	-------	67,235	76,823	146,862	206,549	.35
Nebraska	-------	-------	17	3,408	31	3,456	-------	-------	-------	-------	-------	-------	3,456	.01
North Dakota	-------	-------	1,002	9,636	281	10,919	-------	-------	-------	-------	-------	-------	10,919	.02
Ohio	54	6,436	9,101	85,977	171	101,739	4,155	2,251	2,772	80,617	27,441	117,236	218,975	.38
South Dakota	-------	6	950	18,734	449	20,139	63	-------	-------	-------	-------	63	20,202	.03
Wisconsin	-------	1,401	95,744	190,065	39,982	327,192	17,590	2,657	-------	85,229	293,296	398,772	725,964	1.25
Total North Central	54	27,119	243,248	777,092	54,433	1,101,946	31,794	52,609	11,954	241,845	573,124	911,326	2,013,272	3.47
South Central States:														
Kentucky	-------	42	50	294	-------	386	-------	-------	91	-------	-------	91	477	(1)
All others [2]	-------	410	-------	36	-------	446	-------	-------	139	-------	162	301	747	(1)
Total South Central	-------	452	50	330	-------	832	-------	-------	230	-------	162	392	1,224	(1)
Unknown destinations [3]	-------	832	15,973	23,547	8,431	48,783	1,994	3,820	1,016	-------	-------	6,830	55,613	.10
Total United States	114,288	2,918,814	10,070,276	13,325,356	5,399,535	31,828,269	7,648,519	4,700,089	6,215,336	2,354,670	1,275,209	22,193,823	54,022,092	93.18
Canada:														
Province:														
New Brunswick	1,034	5,783	12,650	20,497	984	40,948	1,279	395	-------	-------	89	1,763	42,711	.07
Nova Scotia	111	6,693	16,557	21,593	1,823	46,777	4,397	3,288	-------	-------	-------	7,685	54,462	.09
Ontario	7,590	342,220	980,162	712,345	80,850	2,123,167	156,821	120,282	19,360	1,497	1,499	299,459	2,422,626	4.18
Quebec	-------	105,607	355,848	209,401	32,902	703,758	314,316	236,736	95,656	18,414	1,729	666,851	1,370,609	2.37
All other Provinces [4]	-------	210	1,718	3,020	85	5,033	4,364	1,292	-------	-------	-------	5,656	10,689	.02
Total Canada [5]	8,735	460,513	1,366,935	966,856	116,644	2,919,683	481,177	361,993	115,016	19,911	3,317	981,414	3,901,097	6.73
Other countries	-------	138	176	110	-------	424	46,618	-------	-------	4,706	-------	51,324	51,748	.09
Grand total	123,023	3,379,465	11,437,387	14,292,322	5,516,179	34,748,376	8,176,314	5,062,082	6,330,352	2,379,287	1,278,526	23,226,561	57,974,937	100.00

[1] Less than 0.005 percent.
[2] Includes Alabama, Louisiana, Tennessee, and Texas.
[3] Coal sold principally to over-the-road truckers for delivery outside the "local sales" area, and for which final destinations were not known.
[4] Includes Manitoba, Prince Edward Island, and Saskatchewan.
[5] Shipments reported to final Canadian destinations by American and Canadian wholesalers were as shown—3,901,097 net tons. American producers and wholesalers reported direct shipments to final Canadian destinations, as well as to Canadian wholesalers, in the amount of 3,900,702 net tons. This minor difference indicates almost complete reporting on the part of companies engaged in supplying the Canadian trade. Official data of the United States Department of Commerce shows total exports to Canada of 3,971,097 net tons during the coal year 1944–45.

TABLE 19.—Shipments of Pennsylvania anthracite, Apr. 1, 1945–Mar. 31, 1946, by States, Provinces, and countries of destination, in net tons

Destination	Domestic sizes						Steam sizes						Total all sizes	Percent of total
	Broken	Egg	Stove	Chestnut	Pea	Total domestic sizes	Buckwheat No. 1	Buckwheat No. 2 (Rice)	Buckwheat No. 3 (Barley)	Buckwheat No. 4	All other sizes	Total steam sizes		
United States:														
New England States:														
Connecticut	402	74,744	448,030	485,872	69,283	1,078,331	91,493	52,876	43,696	421	13	188,499	1,266,830	2.44
Maine	-------	33,966	141,549	129,794	11,269	316,578	22,443	9,325	106	-------	-------	31,874	348,452	.67
Massachusetts	1,563	394,019	1,047,169	749,926	72,507	2,265,184	157,419	103,285	57,853	-------	6	318,563	2,583,747	4.98
New Hampshire	-------	22,777	96,875	79,785	4,504	203,941	28,358	14,311	77,277	728	631	121,305	325,246	.63
Rhode Island	-------	43,501	141,735	122,378	22,118	329,732	36,426	12,889	-------	21	3	49,339	379,071	.73
Vermont	382	13,889	102,882	80,502	7,811	205,466	39,147	15,705	18,480	-------	-------	73,332	278,798	.54
Total New England	2,347	582,896	1,978,240	1,648,257	187,492	4,399,232	375,286	208,391	197,412	1,170	653	782,912	5,182,144	9.99
Middle Atlantic States:														
New Jersey	3,424	246,040	1,231,045	2,122,509	645,311	4,248,329	1,005,504	776,745	1,710,717	384,074	101,912	3,978,952	8,227,281	15.86
New York	20,962	1,383,701	3,746,125	3,601,451	1,247,727	9,999,966	3,699,464	1,375,244	913,760	161,693	375,323	6,525,484	16,525,450	31.85
Pennsylvania [1]	84,612	253,683	1,363,285	3,302,594	2,549,431	7,553,605	1,533,680	1,584,733	2,606,156	1,182,157	547,592	7,454,318	15,007,923	28.93
Total Middle Atlantic	108,998	1,883,424	6,340,455	9,026,554	4,442,469	21,801,900	6,238,648	3,736,722	5,230,633	1,727,924	1,024,827	17,958,754	39,760,654	76.64
South Atlantic States: [2]														
Delaware	534	10,548	80,586	163,270	27,830	282,768	15,750	10,315	11,737	54	13,054	50,910	333,678	.64
District of Columbia	56	18,855	88,052	98,329	23,568	228,860	32,959	2,981	2,449	-------	-------	38,389	267,249	.52
Maryland	1,513	56,861	290,642	285,598	63,141	697,755	112,197	11,781	55,301	3,520	5,901	188,700	886,455	1.71
Virginia	-------	5,790	33,036	47,182	3,106	89,114	30,333	1,237	380	-------	10,331	42,281	131,395	.25
Total South Atlantic	2,103	92,054	492,316	594,379	117,645	1,298,497	191,239	26,314	69,867	3,574	29,286	320,280	1,618,777	3.12
Lake States: [3]														
Illinois	-------	5,269	37,806	156,569	4,565	204,209	1,359	24,766	6,516	28,730	34,658	96,029	300,238	.58
Michigan	189	7,006	77,717	117,132	1,412	203,456	7,008	2,650	3,040	10,079	112,323	135,100	338,556	.65
Minnesota	-------	282	10,746	43,916	4,092	59,036	1,961	464	-------	45,807	87,718	135,950	194,986	.38
Ohio	46	5,459	8,954	76,173	134	90,766	2,636	1,747	2,889	10,766	13,852	31,890	122,656	.24
Wisconsin	-------	2,564	119,984	224,518	42,416	389,482	19,396	2,623	-------	68,486	119,310	209,815	599,297	1.15
Total Lake States	235	20,580	255,207	618,308	52,619	946,949	32,360	32,250	12,445	163,868	367,861	608,784	1,555,733	3.00
All other States	-------	4,032	18,880	159,714	12,053	194,679	9,513	3,661	14,207	2,415	37,375	67,171	261,850	.50
Total United States	113,683	2,582,986	9,085,098	12,047,212	4,812,278	28,641,257	6,847,046	4,007,338	5,524,564	1,898,951	1,460,002	19,737,901	48,379,158	93.25

See footnotes at end of table.

TABLE 19.—Shipments of Pennsylvania anthracite, Apr. 1, 1945–Mar. 31, 1946, by States, Provinces, and countries of destination, in net tons—Continued

Destination	Domestic sizes						Steam sizes						Total all sizes	Percent of total
	Broken	Egg	Stove	Chestnut	Pea	Total domestic sizes	Buckwheat No. 1	Buckwheat No. 2 (Rice)	Buckwheat No. 3 (Barley)	Buckwheat No. 4	All other sizes	Total steam sizes		
Canada:														
Province:														
Ontario	18,243	310,335	819,726	601,944	74,688	1,824,936	143,294	111,512	12,713	352	1,109	268,980	2,093,916	4.04
Quebec		107,516	310,086	196,944	23,559	638,105	264,855	198,415	54,406	21,887	868	540,431	1,178,536	2.27
Other Provinces	660	14,626	31,069	38,539	3,614	88,508	7,727	5,528			97	13,352	101,860	.20
Unknown destinations	232	1,259	10,163	10,471	1,304	23,429	37,216	23,158	10,083	157		70,614	94,043	.18
Total Canada [4]	19,135	433,736	1,171,044	847,898	103,165	2,574,978	453,092	338,613	77,202	22,396	2,074	893,377	3,468,355	6.69
Other countries [5]				160		160	18,349		6,018	7,991	20	32,378	32,538	.06
Grand total	132,818	3,016,722	10,256,142	12,895,270	4,915,443	31,216,395	7,318,487	4,345,951	5,607,784	1,929,338	1,462,096	20,663,656	51,880,051	100.00

[1] Includes "local sales."

[2] Total shipments to other States generally referred to as being in the South Atlantic area are included in "All other States."

[3] Shipments to Indiana are included in "All other States."

[4] Reported shipments by American producers and wholesalers to final Canadian destinations as well as to Canadian wholesalers were as shown—3,468,355 tons. The total shown for "Unknown destinations," 94,043 tons, represents tonnage on which final Canadian destinations were not supplied by Canadian wholesalers. Official data of the United States Department of Commerce show total exports to Canada of 3,529,042 tons during the 1945–46 coal year.

[5] Coverage on anthracite shipments to foreign countries, other than Canada, is not complete. United States Department of Commerce data show total exports to foreign countries, other than Canada, of 378,328 tons during the 1945–46 coal year.

TABLE 20.—Shipments of Pennsylvania anthracite, April 1, 1944–March 31, 1945, by method of movement, in net tons

[As reported to Bureau of Mines by producers and wholesalers on Solid Fuels Administration for War form SFA–26]

	Domestic sizes					
	Broken	Egg	Stove	Chestnut	Pea	Total domestic sizes
Rail	12,458	2,556,004	9,055,807	10,172,098	2,679,101	24,475,468
Tidewater	6,296	608,807	1,021,888	900,951	443,189	2,981,131
Lake		14,082	142,957	267,063	45,005	469,107
Truck [1]	397	90,344	845,799	1,595,587	612,076	3,144,203
Total retail dealers	19,151	3,269,237	11,066,451	12,935,699	3,779,371	31,069,909
All other shipments [2]	67,183	85,711	155,255	330,986	208,985	848,120
Local sales [3]	36,689	24,517	215,681	1,025,637	1,527,823	2,830,347
Grand total	123,023	3,379,465	11,437,387	14,292,322	5,516,179	34,748,376

	Steam sizes						Total all sizes	
	Buckwheat No. 1	Buckwheat No. 2 (Rice)	Buckwheat No. 3 (Barley)	Buckwheat No. 4	All other sizes	Total steam sizes	Net tons	Percent of total
Rail	3,666,748	2,120,609	302,209	21,254	1,739	6,112,559	30,588,027	52.76
Tidewater	2,585,419	835,413	253,189	6,784	1,893	3,682,698	6,663,829	11.49
Lake	36,444	9,251	139	137,807	85,496	269,137	738,244	1.27
Truck [1]	392,883	198,601	57,026	2,382		650,892	3,795,095	6.55
Total retail dealers	6,681,494	3,163,874	612,563	168,227	89,128	10,715,286	41,785,195	72.07
All other shipments [2]	883,590	1,186,299	4,506,826	1,819,498	1,185,143	9,581,356	10,429,476	17.99
Local sales [3]	611,230	711,909	1,210,963	391,562	4,255	2,929,919	5,760,266	9.94
Grand total	8,176,314	5,062,082	6,330,352	2,379,287	1,278,526	23,226,561	57,974,937	100.00

[1] Shipments by over-the-road trucks from the mines to destinations outside the "local sales" area.
[2] Includes shipments to industrials, utilities, railroads, Government agencies, institutions, etc.; this tonnage was transported by all methods of movement and was not separable by type of carrier.
[3] This tonnage was transported principally by truck.

TABLE 21.—Rail shipments of Pennsylvania anthracite, 1944–46, by destinations, in net tons

[Pennsylvania Department of Mines]

Destination	1944	1945	1946
New England States	6,003,552	4,867,051	5,367,460
New York	16,821,928	13,867,150	15,440,475
New Jersey	9,465,559	7,963,782	7,945,666
Pennsylvania	11,693,186	9,647,371	11,360,229
Delaware	317,539	297,056	389,100
Maryland	905,993	784,863	816,268
District of Columbia	323,923	269,278	280,324
Virginia	147,013	128,642	126,187
Ohio	136,781	109,508	96,179
Indiana	85,124	87,123	100,077
Illinois	463,936	529,549	343,354
Wisconsin	392,696	470,501	524,066
Minnesota	146,857	108,210	55,231
Michigan	245,751	239,031	285,351
Other States	64,325	72,573	65,502
Total United States	47,214,163	39,441,688	43,195,469
Canada	3,675,870	3,059,062	3,818,303
Other foreign countries	5,118	16,079	
Grand total	50,895,151	42,516,829	47,013,772

TABLE 22.—Truck shipments of Pennsylvania anthracite in 1946, by months, and by States of destination, in net tons [1]

Destination	January	February	March	April	May	June	July
Pennsylvania:							
Within region	486,729	450,974	460,341	366,719	432,828	179,533	147,631
Outside region	201,232	177,375	235,281	188,412	194,928	99,147	142,329
New York	68,069	48,445	109,444	65,037	79,386	41,982	24,245
New Jersey	69,121	70,459	84,184	64,539	71,957	38,485	43,353
Delaware	9,481	4,607	4,276	3,026	2,602	793	430
Maryland	4,124	6,593	12,329	4,713	5,115	1,950	2,045
District of Columbia			166	119	7		
Other States	1,432	1,107	1,923	1,313	1,618	793	755
Total: 1946	840,188	759,560	907,944	693,878	788,441	362,683	360,788
1945	799,898	803,065	606,448	707,774	305,759	676,993	582,822

Destination	August	September	October	November	December	Total	Percent of total trucked
Pennsylvania:							
Within region	202,872	252,884	337,214	379,607	393,313	4,090,645	53.4
Outside region	149,521	167,593	177,298	172,627	167,906	2,073,649	27.1
New York	22,396	49,011	59,092	48,786	46,997	662,890	8.7
New Jersey	46,552	48,065	77,722	56,233	47,173	717,843	9.4
Delaware	522	1,345	2,121	2,583	2,893	34,679	.4
Maryland	1,397	6,658	5,617	5,335	6,051	61,927	.8
District of Columbia						292	(2)
Other States	1,032	1,337	1,266	1,943	1,646	16,165	.2
Total: 1946	424,292	526,893	660,330	667,114	665,979	7,658,090	100.0
1945	608,668	565,641	628,881	543,806	766,354	7,596,109	100.0

[1] Compiled from reports of Pennsylvania Department of Mines.
[2] Less than 0.05 percent.

TABLE 23.—Receipts of anthracite in New England, 1917, 1920, 1923, and 1927–46, in thousands of net tons

Year	Receipts by tidewater [1]						Receipts by rail [1]	Imports [2]	Total receipts of Pennsylvania anthracite [3]
	Maine	New Hampshire	Massachusetts	Rhode Island	Connecticut	Total			
1917	432	47	2,222	555	1,165	4,421	7,259	1	11,679
1920	307	6	2,015	450	743	3,521	7,804	1	11,324
1923	437	27	2,216	511	891	4,082	8,102	145	12,039
1927	242	33	1,220	311	615	2,421	6,725	106	9,040
1928	205	35	1,373	301	528	2,442	6,934	369	9,007
1929	237	17	1,227	329	450	2,260	6,781	483	8,558
1930	275	17	1,236	271	422	2,221	6,169	658	7,732
1931	164	18	1,125	282	348	1,937	5,125	611	6,451
1932	148	10	1,014	212	275	1,659	3,980	574	5,065
1933	195	7	1,027	202	259	1,690	3,562	443	4,809
1934	168	20	946	190	266	1,590	4,382	477	5,495
1935	121	7	802	205	237	1,372	4,030	559	4,843
1936	127	14	792	198	267	1,398	3,889	612	4,675
1937	81	11	604	152	200	1,048	3,713	395	4,366
1938	93	2	554	137	191	977	3,491	363	4,105
1939	74	3	488	83	227	875	4,027	298	4,604
1940	48	4	350	74	172	648	4,174	135	4,687
1941	57	9	348	58	210	682	4,870	75	5,477
1942	(4)	(4)	(4)	(4)	(4)	581	5,393	139	5,835
1943						575	5,310	164	5,721
1944						398	5,836	12	6,222
1945						331	4,750	(5)	5,081
1946						408	5,244	9	5,643

[1] Commonwealth of Massachusetts, Division on the Necessaries of Life.
[2] U. S. Department of Commerce.
[3] Total receipts by rail and by tidewater less imports.
[4] Data not available.
[5] Less than 1,000 tons.

Shipments of anthracite from the Lehigh, Schuylkill, and Wyoming regions, 1850 to 1946, inclusive, are presented graphically in figure 1.

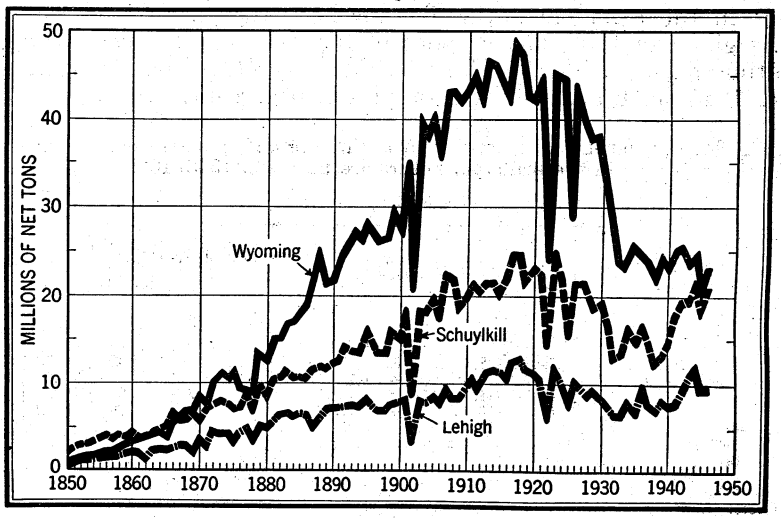

FIGURE 1.—Anthracite shipped from the Lehigh, Schuylkill, and Wyoming regions, 1850–1946.

CONSUMPTION

Consumption of anthracite in the United States in 1946, including colliery fuel and river coal, totaled 53,900,000 net tons compared with 51,600,000 tons in 1945. These data are based on production, imports, exports, and changes in producers' stocks but do not consider changes in stocks held by retail dealers, as data on stocks held by this group are incomplete. Consumption of anthracite by class 1 railroads amounted to 1,079,028 tons, an increase of 7 percent over 1945; electric power utilities used 3,453,326 tons, an increase of 11 percent over 1945. The fuel-briquet industry affords a large market for anthracite fines, and anthracite used in 1946 in the manufacture of briquets totaled 1,098,999 tons compared with 1,285,399 tons of bituminous coal used by that industry.

Competitive Fuels in the United States and Principal Markets.—Of the total shipments of anthracite to points in the United States, about 97 percent is destined to the New England and Middle Atlantic States, Maryland, Delaware, and the District of Columbia. Data on the consumption of all fuels in this market are not available; however, apparent consumption of anthracite, domestic coke, briquets, and heating and range oils, in terms of anthracite, totaled 80,111,000 net tons in 1945, a 6-percent decline from 1944. The decrease is attributable largely to decreased shipments of anthracite in 1945. Despite the decline in anthracite shipments, this fuel accounted for 56 percent of the consumption of these fuels in this area in 1945; oil 39 percent; and coke 5 percent. In addition to the recognized anthracite shipped, large quantities of "bootleg" coal, on which data are not available, are moved by truck to this area. Com-

plete data on these fuels for this market in 1946 are not available, but it is expected that total consumption will show a substantial increase over that of 1945. Details on consumption of competitive fuels in the principal anthracite markets are shown in table 24.

As given in table 25, supplies of fuels commonly used for space-heating purposes in the United States increased generally in 1946 over 1945, anthracite showing a gain of 6 percent.

TABLE 24.—Apparent consumption of anthracite and selected competitive fuels in the principal anthracite markets, 1943–46

[Thousands of net tons]

Fuel	New England	New York	New Jersey	Pennsylvania	Delaware	Maryland	District of Columbia	Total	Percent of total fuels
Anthracite:									
All users:[1]									
1943	5,604	[2]18,555	[2]9,527	16,540	362	873	320	51,781	61.7
1944	6,004	[2]17,489	[2]10,254	17,744	380	1,016	325	53,212	62.3
1945	4,867	[2]14,488	[2]8,666	15,776	343	868	270	45,278	56.5
1946	5,367	[2]16,103	[2]8,663	17,525	424	878	281	49,241	(3)
Imports:[4]									
1943	164	2						166	.2
1944	12							12	(5)
1945								(6)	(5)
1946									(3)
Briquets:									
Domestic use:									
1943	53	31	2	27	(6)	4	1	118	.1
1944	76	48	12	45	3	7	1	192	.2
1945	83	67	16	52	3	10	2	233	.3
1946	121	94	28	50	4	21	2	320	(3)
Imports:[4]									
1943								(6)	(5)
1944								(6)	(5)
1945								(6)	(5)
1946								(6)	(3)
Coke:									
Domestic use:									
1943	1,265	969	329	321	3	1	(6)	2,888	3.4
1944	1,352	1,232	464	386	7	4	1	3,446	4.1
1945	1,371	1,375	552	334	5	2	2	3,641	4.6
1946	1,085	987	469	291	3	5	(6)	2,840	(3)
Imports:[4]									
1943	1	52						53	.1
1944	(6)	23						23	(5)
1945	1	19						20	(5)
1946	(6)	11						11	(3)
Oil: Heating and range:[7]									
1943	10,367	9,795	4,490	2,620	144	970	552	28,938	34.5
1944	10,411	9,554	4,442	2,496	140	988	526	28,557	33.4
1945	11,205	10,095	5,037	2,728	154	1,136	584	30,939	38.6
1946	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Total fuel:[8]									
1943	17,454	29,404	14,348	19,508	509	1,848	873	83,944	100.0
1944	17,855	28,346	15,172	20,671	530	2,015	853	85,442	100.0
1945	17,527	26,044	14,271	18,890	505	2,016	858	80,111	100.0
1946	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)

[1] Pennsylvania Department of Mines; illicit coal not included.
[2] An important but undetermined part of anthracite shown as shipped to New Jersey is reshipped to New York City.
[3] Data not yet available.
[4] U. S. Department of Commerce.
[5] Less than 0.05 percent.
[6] Less than 1,000 tons.
[7] Converted to coal equivalent upon basis of 4 barrels of fuel oil equaling 1 ton of coal.
[8] Excludes bituminous coal.

TABLE 25.—Total supplies of fuels commonly used for space-heating purposes in the United States, 1937 and 1943–46

[Wherever available, figures represent quantity actually consumed for domestic heating or for space heating offices, apartments, hotels, schools, hospitals, etc. Where such figures are not available but where the fuel is known to be used chiefly for domestic or space-heating purposes, total production (or imports) is shown to indicate trend of growth]

	1937	1943	1944	1945	1946
SOLID FUELS (NET TONS)					
Anthracite:					
Production:					
Shipments of domestic sizes	29,092,974	32,563,787	34,343,434	28,610,174	31,607,802
Shipments of Buckwheat No. 1	6,859,707	7,537,642	8,083,664	6,681,171	7,181,843
Shipments of smaller steam sizes [1]	10,250,463	13,934,408	15,213,472	13,251,106	15,318,942
Local sales	2,981,391	4,233,732	3,765,641	4,273,864	4,435,536
Total commercial production	49,184,535	58,269,569	61,406,211	52,816,315	58,544,123
Exports [2]	1,914,173	4,138,680	4,185,933	3,691,247	6,506,829
Imports for consumption [2]	395,737	166,020	11,847	149	9,556
Fuel briquets [3]	977,254	1,989,223	2,301,827	2,588,819	2,841,341
Packaged-fuel production	146,037	215,605	175,770	208,143	190,919
Coke:					
Oven coke sales for domestic use	7,807,792	4,784,090	6,443,329	6,574,526	4,947,085
Beehive sales for domestic use	299,726	101,438	274,214	200,982	149,648
Imports for consumption [2]	286,364	98,127	63,004	51,964	52,188
Retort coke sales	[4] 350,700	518,825	423,675	431,361	355,336
Petroleum-coke production	1,306,600	1,388,400	1,803,400	2,023,000	2,124,200
Anthracite and semianthracite production outside of Pennsylvania	468,852	[5]	[5]	[5]	[5]
Lignite production [6]	3,218,419	2,749,393	2,554,160	2,668,310	2,667,619
Bituminous-coal sales for domestic use	[5]	[5]	[5]	[5]	[5]
OIL (BARRELS OF 42 GALLONS)					
Oil sales for heating buildings:					
Range oil	32,259,000	44,097,000	47,636,000	51,021,000	[9] 62,500,000
Heating oils (domestic and commercial) [10]	116,617,000	155,251,000	152,203,000	165,216,000	[9] 187,000,000
Liquefied petroleum gases (domestic)	972,000	8,080,000	10,442,000	12,697,000	18,242,000
GAS (MILLION CUBIC FEET)					
Natural-gas consumption for domestic and commercial use [11]	489,234	734,237	782,930	837,499	887,300
Manufactured-gas sales for: [12]					
Domestic use	193,325	208,397	215,157	[7]	[7]
House heating	45,200	83,686	84,766	[7]	[7]

[1] A considerable part of the smaller steam sizes is used by industries, railroads, and public utilities.
[2] U. S. Department of Commerce.
[3] Production plus imports less exports.
[4] Partly estimated.
[5] Data not available.
[6] An estimated one-half of total production shown is used for domestic purposes.
[7] Data not yet available.
[8] Exact data not available.
[9] Estimated.
[10] Includes all grades of fuel oil used for heating buildings.
[11] Includes gas used for heating offices, hotels, apartments, hospitals, stores, and other large buildings, as well as houses.
[12] American Gas Association.

Mechanical Stokers and Oil Burners.—According to the Bureau of the Census, United States Department of Commerce, factory sales of class 1 mechanical stokers for burning anthracite (capacity under 61 pounds of coal per hour) increased from 3,325 units in 1945 to 7,044 units in 1946. Sales of class 2 stokers (capacity 61 to 100 pounds of coal per hour) declined from 1,883 units in 1945 to 908 units in 1946. With the lifting of Government restrictions and greater availability of electric motors, shipments of oil burners for central heating plants and for industrial uses increased from 182,130 units in 1945 to 579,453 units in 1946. In 1941 shipments of oil burners totaled 303,869 units.

STOCKS

Producers' stocks, which reached a low point of 63,459 net tons in June, increased to a total of 251,168 tons in December, an increase of 93 percent over December 1945. Virtually all of the coal in storage was Buckwheat No. 2 and smaller sizes; very little tonnage of the domestic sizes was available at any time during the year. Stocks on the upper Lake docks declined 14 percent, while those held by public utilities and class 1 railroads increased 8 percent and 4 percent, respectively, over stocks held by these industries on December 31, 1945.

PRICES

The wage agreement of June 7, 1946, between the anthracite producers and the United Mine Workers of America added considerably to production costs; to compensate the operators for the additional costs the Office of Price Administration authorized, on June 25, for both producer groups 1 and 2, the following price increases: Broken, Egg, Stove, and Chestnut sizes, $1.15 per net ton; Pea, $1.00; Buckwheat No. 1, $0.70; Rice, $0.60; Barley, $0.50; and smaller than Barley sizes, $0.40 per net ton. With a few exceptions, group 1 prices were applicable to the nine larger anthracite-producing companies and group 2 to all other anthracite producers. The procedure of applying different prices to groups of producers was followed in World War I, when a number of the large companies were given lower prices than the other producers at that time. On November 9, 1946, the Price Administrator abolished virtually all price controls, including those on coal. At the end of the year the prices had not changed from those established by the Office of Price Administration effective June 25, 1946, as shown in table 27.

Retail prices of anthracite, bituminous coal, coke, and heating oils in selected cities, by months, in 1946 are shown in table 26. These prices were compiled from reports of the Bureau of Labor Statistics, United States Department of Labor.

TABLE 26.—Retail prices of selected fuels in 1946, by cities and months [1]

[Coal and coke, per net ton; heating oil, per 100 gallons]

City and fuel	January	February	March	April	May	June	July	August	September	October	November	December
Baltimore, Md.:												
Anthracite:												
Stove	$14.40	$14.39	$14.39	$14.39	$14.39	$14.39	$15.61	$15.61	$15.83	$15.92	$15.92	$15.93
Buckwheat No. 1	10.90	10.89	10.89	10.89	10.89	10.89	11.65	11.65	11.87	11.96	11.96	11.98
Bituminous coal, low-volatile Stove	11.25	11.25	11.28	11.28	11.28	11.28	11.94	11.94	12.14	12.14	12.12	----------
Coke, Egg	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
Heating oil:												
Fuel oil No. 2	7.75	8.00	8.00	8.00	8.00	8.00	8.00	8.60	8.60	8.60	8.60	8.90
Fuel oil No. 3	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
Boston, Mass.:												
Anthracite:												
Stove	16.88	16.89	16.89	16.89	16.89	16.89	18.12	18.15	18.42	18.42	18.42	18.42
Buckwheat No. 1	12.63	12.64	12.64	12.64	12.64	12.64	13.47	13.50	13.72	13.72	13.72	13.72
Bituminous coal, low-volatile Stove	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
Coke, Egg	15.29	15.29	15.29	15.29	15.29	15.44	16.64	16.67	16.91	16.94	16.94	16.94
Heating oil:												
Fuel oil No. 2	7.75	8.00	8.08	8.10	8.10	8.10	8.10	8.80	8.63	8.60	8.60	8.76
Fuel oil No. 3	7.70	7.95	7.95	8.10	8.10	8.10	8.10	8.80	8.70	----------	----------	----------
Buffalo, N. Y.:												
Anthracite:												
Stove	15.04	15.04	15.04	15.04	15.04	15.04	16.27	16.27	16.57	16.57	16.57	16.56
Buckwheat No. 1	10.64	10.64	10.64	10.64	10.64	10.64	11.41	11.41	11.68	11.71	11.71	----------
Bituminous coal, low-volatile Stove	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
Coke, Egg	11.62	11.62	11.62	11.64	11.64	11.64	12.99	12.99	13.29	13.29	13.53	[2] 13.65
Heating oil:												
Fuel oil No. 2	8.50	8.88	8.88	9.00	9.00	9.00	9.00	9.70	10.40	10.40	10.40	10.50
Fuel oil No. 3	8.50	9.00	9.00	9.00	9.00	9.00	9.00	9.70	10.40	10.40	10.40	10.50
Chicago, Ill.: [3]												
Anthracite:												
Stove	18.07	18.07	18.07	18.09	18.09	18.09	19.34	19.34	19.54	19.58	19.60	----------
Buckwheat No. 1	14.19	14.19	14.19	14.19	14.19	14.19	14.97	14.97	15.17	15.20	15.27	----------
Bituminous coal, low-volatile Stove	12.98	12.98	12.98	12.98	13.25	13.38	13.69	13.65	13.79	13.81	13.83	14.21
Coke, Egg	15.56	15.56	15.56	15.59	16.06	16.18	16.93	16.93	17.17	17.23	17.26	[2] 17.62
Heating oil:												
Fuel oil No. 2	7.45	7.88	7.88	7.88	7.96	7.96	7.96	8.29	8.36	8.36	8.36	8.87
Fuel oil No. 3	7.45	7.89	7.89	7.89	7.96	7.96	7.96	8.30	8.36	8.36	8.36	8.87
Milwaukee, Wis.:												
Anthracite:												
Stove	16.56	16.58	16.60	16.60	16.70	16.70	17.99	17.76	18.09	18.09	18.09	18.09
Buckwheat No. 1	12.86	12.86	12.87	12.87	12.97	12.97	13.79	13.56	13.89	13.89	13.89	----------
Bituminous coal, low-volatile Stove	13.60	13.60	13.60	13.60	13.79	14.15	14.35	14.12	14.34	14.34	14.34	14.32
Coke, Egg	14.29	14.29	14.29	14.29	14.89	15.34	15.64	15.64	15.94	15.94	15.94	[2] 15.9

See footnotes at end of table.

TABLE 26.—Retail prices of selected fuels in 1946, by cities and months [1]—Continued

[Coal and coke, per net ton; heating oil, per 100 gallons]

City and fuel	January	February	March	April	May	June	July	August	September	October	November	December
Milwaukee, Wis.—Continued												
Heating oil:												
Fuel oil No. 2	$8.12	$8.50	$8.50	$8.50	$8.50	$8.50	$8.50	$8.80	$8.80	$8.80	$8.80	$9.30
Fuel oil No. 3	8.17	8.50	8.50	8.50	8.50	8.50	8.50	8.80	8.80	8.80	8.80	9.30
New York, N. Y.: [4]												
Anthracite:												
Stove	15.34	15.52	15.52	15.51	15.51	15.51	16.87	16.89	17.14	17.10	17.10	17.10
Buckwheat No. 1	10.64	10.72	10.72	10.73	10.73	10.73	11.66	11.69	[5] 11.60	[5] 11.54	[5] 11.54	[5] 11.54
Bituminous coal, low-volatile Stove												
Coke, Egg	15.08	15.23	15.23	15.23	15.23	15.38	16.15	16.15	16.43	[2] 16.72	[2] 16.74	[2] 16.74
Heating oil:												
Fuel oil No. 2	7.70	8.08	8.08	8.08	8.08	8.08	8.16	8.87	8.95	8.97	8.73	9.04
Fuel oil No. 3												
Philadelphia, Pa.:												
Anthracite:												
Stove	14.60	14.57	14.57	14.54	14.55	14.56	15.80	15.78	16.08	16.08	16.05	16.05
Buckwheat No. 1	10.60	10.57	10.57	10.54	10.55	10.56	11.35	11.33	11.63	11.63	11.60	11.60
Bituminous coal, low-volatile Stove												
Coke, Egg	13.89	13.87	13.87	13.85	13.85	13.85	14.66	14.76	15.12	15.17	15.16	15.26
Heating oil:												
Fuel oil No. 2	7.61	7.93	7.93	7.95	7.93	7.93	7.93	8.43	8.43	8.43	8.43	8.63
Fuel oil No. 3	7.58	7.91	7.91	7.92	7.92	7.92	7.92	8.42	8.42	8.42	8.42	8.62
Portland, Maine:												
Anthracite:												
Stove	16.88	16.88	16.88	16.88	16.88	16.88	18.11	18.11	18.41	18.41	18.47	18.47
Buckwheat No. 1	12.38	12.38	12.38	12.38	12.38	12.38	13.16	13.16	13.46	13.46	13.52	13.52
Bituminous coal, low-volatile Stove												
Coke, Egg	15.18	15.18	15.18	15.18	15.18	15.18	16.61	16.61	16.91	16.91	16.91	16.91
Heating oil:												
Fuel oil No. 2	7.70	8.00	8.00	8.00	8.00	8.00	8.00	8.70	8.60	8.60	8.60	8.80
Fuel oil No. 3												
Washington, D. C.:												
Anthracite:												
Stove	14.58	14.58	14.61	14.61	14.61	14.61	15.84	15.84	16.14	16.14	16.14	16.14
Buckwheat No. 1	10.58	10.52	10.52	10.52	10.52	10.52	11.30	11.30	11.60	11.60	11.60	11.60
Bituminous coal, low-volatile Stove	11.36	11.36	11.35	11.35	11.35	11.35	12.02	12.02	12.20	12.20	12.20	12.20
Coke, Egg	13.64	13.64	13.64	13.64	13.64	13.64	14.28	14.28	14.54	14.54	14.54	14.54
Heating oil:												
Fuel oil No. 2	8.10	8.36	8.36	8.36	8.40	8.40	8.40	9.00	9.00	9.00	9.04	9.30
Fuel oil No. 3												

[1] Compiled from reports of Bureau of Labor Statistics. Prices are as of the 15th of each month. Data are preliminary.
[2] Chestnut size.
[3] Includes 2 percent sales tax.
[4] Includes 1 percent sales tax January-June; 2 percent July-December.
[5] Commercial.

TABLE 27.—Maximum prices per net ton for Pennsylvania anthracite as established by the Office of Price Administration, effective June 25, 1946

	Broken	Egg	Stove	Chestnut	Pea	Buckwheat No. 1	Buckwheat No. 2 (Rice)	Buckwheat No. 3 (Barley)	All other sizes [1]
Group I:									
Glen Alden Coal Co Hudson Coal Co Jeddo Highland Coal Co Lehigh Navigation Coal Co Lehigh Valley Coal Co Pennsylvania Coal Co Philadelphia & Reading Coal & Iron Co Stevens Coal Co Susquehanna Collieries Co	$10.15	$10.15	$10.15	$10.15	$8.30	$5.95	$4.90	$3.55	$2.65
Group II:									
All producers not included in Group I	10.65	10.65	10.65	10.65	8.80	6.40	5.20	3.85	2.65
Exceptions:									
Franklin-Lykens Coal Co.: Anthracite prepared at Williamstown breaker. Sold under trade name "The Only Genuine Franklin Coal of Lykens Valley"	10.90	11.15	11.40	10.65	8.80	6.35	5.20	3.85	2.65
Jeddo Highland Coal Co.: Anthracite prepared at Jeddo No. 7 and Highland No. 5 breakers. Sold under trade name "Jeddo Coal" "Highland Coal" or "Hazel Brook Coal"	10.40	10.40	10.40	10.40	8.55	6.20	5.05	3.55	2.65
Lehigh Navigation Coal Co.: Anthracite sold under trade name "Old Company's Lehigh-Greenwood Premium Anthracite"	10.15	10.40	10.40	10.40	8.55	5.95	4.90	3.55	2.65

[1] If sold for fuel, sintering, or the manufacture of calcium carbide, graphite, or activated carbon; includes (specifically but not exclusively) Buckwheat No. 4, river or dredge Barley, and smaller sizes.

EMPLOYMENT

The shortage of labor in the anthracite industry, which existed from 1942 to 1945, inclusive, was relieved in 1946 when the average number of men employed totaled 78,145—a gain of 7 percent over the 72,842 men employed in 1945. The increase in production of 10 percent in 1946 over 1945 can be attributed largely to the gain in employment.

The employment data in this chapter exclude workers in "bootleg" coal mines. According to the Anthracite Committee, 2,817 men were working 863 "bootleg" holes in March 1947. Although these workers are not included in the employment data, the coal produced by some of them was purchased (352,112 net tons in 1946) by the recognized industry for preparation and shipment to market, and coal so purchased is included in the production tables of this chapter. Complete employment data for the "bootleg" holes from which this coal was produced are not available. In calculating the output per man per day, therefore, the tons of "bootleg" coal purchased by the recognized industry were deducted from the total tonnage reported by the operators, and the resulting production was then used to calculate the output per man per day. It is true that part of the time of the

men employed at the preparation plants of the recognized companies was used to prepare this purchased coal for market; however, on a per ton basis this time is insignificant, and its omission will not detract materially from the validity of the result obtained. See tables 28 and 29 for details on labor statistics.

TABLE 28.—Men employed and days worked at operations producing Pennsylvania anthracite in 1946, by regions [1]

[Includes operations of strip contractors]

Region	Average number of men employed							Average number of days plant operated	Man-days of labor	Average tons per man per day
	Underground			Surface			Grand total			
	Miners and their laborers	Other	Total underground	In strip pits	In preparation plant	Other	Total surface			
Lehigh:										
Breaker	4,921	3,811	8,732	1,432	978	2,777	5,187	13,919	264	3,671,228	2.76
Washery [2]	-------	-------	-------	------	105	105	210	210	246	51,729	7.15
Dredge	-------	-------	-------	------	4	9	13	13	219	2,841	13.18
Total Lehigh	4,921	3,811	8,732	1,432	1,087	2,891	5,410	14,142	263	3,725,798	2.83
Schuylkill:										
Breaker	7,088	5,213	12,301	3,663	2,049	3,830	9,542	21,843	261	5,709,352	[3] 3.40
Washery [2]	-------	-------	-------	8	138	783	929	929	233	216,240	8.46
Dredge	-------	-------	-------	------	233	281	514	514	256	131,809	8.24
Total Schuylkill	7,088	5,213	12,301	3,671	2,420	4,894	10,985	23,286	260	6,057,401	[3] 3.69
Wyoming:										
Breaker	20,299	10,575	30,874	1,031	1,996	6,354	9,381	40,255	281	11,330,043	2.31
Washery [2]	-------	-------	-------	------	96	184	280	280	206	57,790	16.01
Dredge	-------	-------	-------	------	8	6	14	14	104	1,456	6.07
Total Wyoming	20,299	10,575	30,874	1,031	2,100	6,544	9,675	40,549	281	11,389,289	2.38
Total, excluding Sullivan County:										
Breaker	32,308	19,599	51,907	6,126	5,023	12,961	24,110	76,017	272	20,710,623	[3] 2.69
Washery [2]	-------	-------	-------	8	339	1,072	1,419	1,419	230	325,759	9.59
Dredge	-------	-------	-------	------	245	296	541	541	252	136,106	8.32
Total	32,308	19,599	51,907	6,134	5,607	14,329	26,070	77,977	272	21,172,488	[3] 2.84
Sullivan County	70	19	89	18	47	14	79	168	204	34,198	3.13
Grand total	32,378	19,618	51,996	6,152	5,654	14,343	26,149	78,145	271	21,206,686	[3] 2.84

[1] Men employed in "bootleg" operations excluded.
[2] Represents washeries for which both production and employment were separately reported.
[3] Output per man per day calculated on legitimate tonnages only; "bootleg" purchases excluded.

TABLE 29.—Men employed at operations producing Pennsylvania anthracite, 1945–46, by counties

[Includes operations of strip contractors]

County	1945	1946	County	1945	1946
Berks, Lancaster, Lebanon, Northampton, and Snyder [1]	104	129	Northumberland	5,572	5,805
Carbon	4,907	5,284	Schuylkill	16,910	18,245
Columbia	1,897	2,015	Sullivan	203	168
Dauphin	327	361	Susquehanna and Wayne	57	62
Lackawanna	11,358	12,012	Total	72,842	78,145
Luzerne	31,507	34,064			

[1] Counties producing dredge coal only.

MINING METHODS AND EQUIPMENT

Mechanical Loading.—The quantity of anthracite loaded mechanically, which decreased considerably in 1945 because of the inability of producers to obtain mechanical coal-loading equipment, increased sharply in 1946, and the output of 15,619,162 net tons is the highest on record. All of the net gain occurred in the Northern field, which is more adaptable to present-day mechanical-loading methods than are the pitching seams in the other three fields. Details on underground mechanically loaded coal are given in tables 30 to 32.

The trend of underground mechanical and hand loading and of strip-pit output in the Pennsylvania anthracite regions, 1928–46, is illustrated graphically in figure 2.

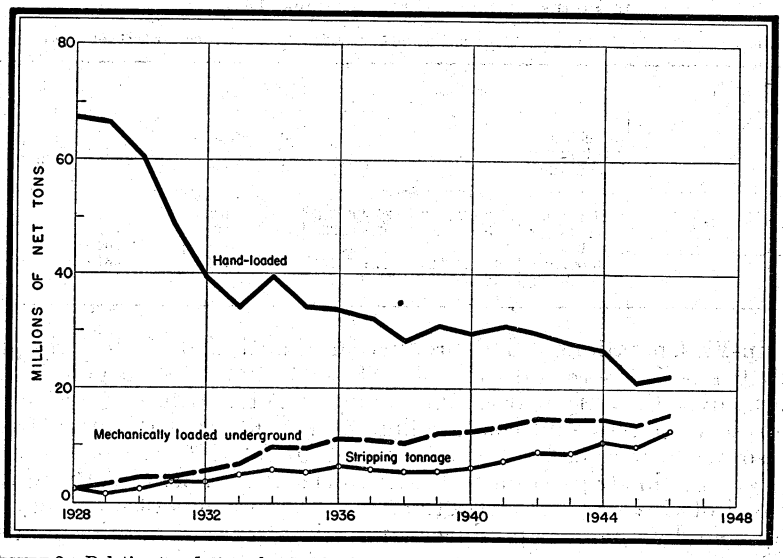

FIGURE 2.—Relative trend of mechanical loading, hand loading, and stripping of Pennsylvania anthracite, 1928–46.

TABLE 30.—Pennsylvania anthracite loaded mechanically underground in 1946, by fields, in net tons

Field	Scraper loaders [1]	Pit-car loaders	Hand-loaded face conveyors, all types [2]	Total mechanically loaded underground
Northern	2,237,897	342,583	10,416,401	12,996,881
Eastern Middle	149,948	68,357	512,204	730,509
Western Middle	398,916	30,039	1,092,517	1,521,472
Southern	8,835	17,367	344,098	370,300
Total	2,795,596	458,346	12,365,220	15,619,162

[1] Includes mobile loaders.
[2] Shaker chutes, etc., including those equipped with duckbills.

TABLE 31.—Pennsylvania anthracite loaded mechanically underground, 1943–46

Year	Scrapers		Mobile loaders		Conveyors and pit-car loaders [1]		Total loaded mechanically	
	Number of units	Net tons loaded	Number of units	Net tons loaded	Number of units	Net tons loaded	Number of units	Net tons loaded
1943	510	2,750,256	5	57,033	2,701	11,938,504	3,216	14,745,793
1944	491	2,811,824	12	69,837	2,807	12,093,485	3,310	14,975,146
1945	548	2,747,254	20	146,209	3,006	11,034,492	3,574	13,927,955
1946	564	2,714,051	27	81,545	3,233	12,823,566	3,824	15,619,162

[1] Includes duckbills and other self-loading conveyors.

TABLE 32.—Relative growth of mechanical loading, hand loading, and stripping in Pennsylvania anthracite mines, 1942–46

[Mechanical loading includes coal handled on pit-car loaders and hand-loaded face conveyors]

Year	Net tons			Index numbers: 1927=100		
	Mechanical loading underground	Stripping	Hand loading	Mechanical loading underground	Stripping	Hand loading
1942	14,741,459	9,070,933	30,495,240	663	421	43
1943	14,745,793	8,989,387	27,990,005	663	417	39
1944	14,975,146	10,953,030	26,800,270	674	509	38
1945	13,927,955	10,056,325	20,957,744	626	467	29
1946	15,619,162	12,858,930	22,465,295	703	597	31

Strip-Pit Operations.—The production of anthracite from strip pits in 1946 reached a record high of 12,858,930 net tons—a gain of 28 percent over the output from this source in 1945. Although recoverable reserves of strip-pit coal are limited, it is likely that output from this source will remain at a relatively high level for several years. The increase in strip-pit output in 1946 is attributable directly to the removal of Government restrictions on the purchases of strip-mining equipment by the coal producers, resulting in a substantial gain in the various kinds of equipment used in strip operations. Details of strip-pit operations are given in tables 33 and 34.

Figure 3 illustrates graphically the production of anthracite from strip pits by regions 1928–46.

TABLE 33.—Power shovels and draglines used in stripping Pennsylvania anthracite, by type of power, 1944–46

Type of power	1944			1945			1946		
	Number of power shovels	Number of draglines	Total	Number of power shovels	Number of draglines	Total	Number of power shovels	Number of draglines	Total
Gasoline	39	24	63	38	21	59	68	20	88
Electric	24	36	60	29	38	67	33	44	77
Diesel	72	178	250	89	202	291	155	254	409
All other	4		4	4		4	6		6
	139	238	377	160	261	421	262	318	580

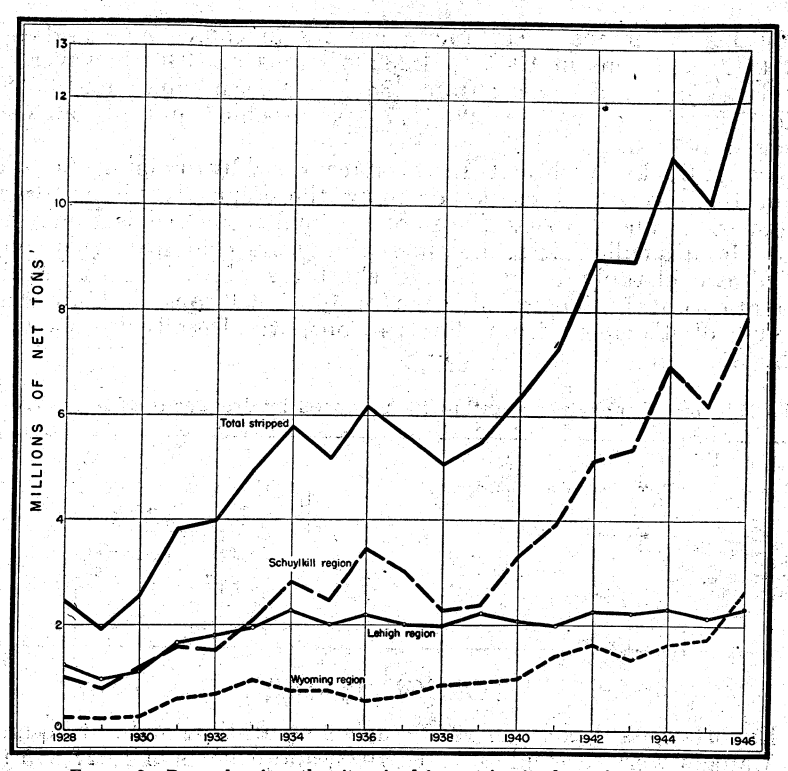

FIGURE 3.—Pennsylvania anthracite mined from strip pits, by regions, 1928–46.

TABLE 34.—Relative growth of Pennsylvania anthracite mined from strip pits, 1915, 1920, 1925, 1930, and 1943–46

	Net tons mined by stripping	Percent of fresh-mined total that was stripped	Number of men employed	Average number of days worked
1915	1,121,603	(1)	(1)	(1)
1920	2,054,441	2.5	(1)	(1)
1925	1,578,478	2.7	(1)	(1)
1930	2,536,288	3.7	(1)	(1)
1943	8,989,387	17.4	5,084	229
1944	10,953,030	20.8	5,595	246
1945	10,056,325	22.4	5,314	238
1946:				
Lehigh region	2,311,437	26.8	1,432	258
Schuylkill region	7,904,006	46.9	3,671	256
Wyoming region	2,621,399	10.3	1,031	233
Total, excluding Sullivan County	12,836,842	25.2	6,134	253
Sullivan County	22,088	26.1	18	97
Grand total 1946	12,858,930	25.2	6,152	252

[1] Data not available.

Cutting Machines.—Anthracite cut by machines increased from 1,210,171 net tons in 1945 to 1,232,828 tons in 1946; however, the machines in use decreased from 225 (189 "permissible" and 36 "all other types") in 1945 to 200 (177 "permissible" and 23 "all other types") in 1946.

Dredge Coal.—Anthracite has been recovered by dredging operations from the rivers and creeks draining the Pennsylvania anthracite region since about 1890. Most of the coal recovered is Buckwheat No. 4 and smaller sizes, and in recent years coal from this source aided considerably in alleviating shortages of fuel in the Middle Atlantic States. The production of 1,132,394 tons in 1946 was a decline of 6 percent from the 1945 output. Details are shown in table 35.

TABLE 35.—Pennsylvania anthracite produced by dredges in 1946, by rivers

River (including tributaries)	Net tons	Value	
		Total	Average
Lehigh	37,441	$66,311	$1.77
Schuylkill	247,757	413,105	1.67
Susquehanna	847,196	1,611,908	1.90
	1,132,394	2,091,324	1.85

FOREIGN TRADE[1]

Exports of anthracite in 1946 reached an all-time high. Shipments to Canada were the highest since 1923, and exports of 1,927,845 tons to Europe were unprecedented. The reason for our large exports to Europe was the inability of Great Britain to export coal to the continental countries in quantities approaching its prewar levels. Shipments to foreign countries in 1947 will doubtless exceed those of 1946. Details on imports and exports are given in tables 36 and 37.

TABLE 36.—Anthracite imported for consumption in the United States, 1945–46, by countries and customs districts, in net tons

Country	1945	1946	Customs district	1945	1946
Canada	10	9,556	Alaska		41
Spain	4		Montana and Idaho		9,515
United Kingdom	135		New York	135	
			Philadelphia	4	
	149	9,556	Vermont	10	
				149	9,556

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

TABLE 37.—Anthracite exported from the United States, 1945–46, by countries and customs districts, in net tons

Country	1945	1946
North America:		
Bermuda	55	278
Canada	3,393,131	4,513,637
Mexico	158	4,450
Newfoundland and Labrador	6,031	4,538
West Indies:		
British	16	157
Cuba	70,171	51,896
Curaçao (N. W. I.)	1	
Other North America	85	14
South America:		
Bolivia	560	34
Brazil	4,480	67
Peru	102	102
Uruguay	159	250
Other South America	2	83
Europe:		
Belgium and Luxembourg	134,769	786,956
France	33,685	758,226
Italy		240,530
Netherlands	2	87,991
Norway		9,099
Portugal	9,287	280
Sweden	12,627	
Switzerland	25,926	24,927
Yugoslavia		19,825
Other Europe		11
Asia: China		3,476
Africa		2
	3,691,247	6,506,829

Customs district	1945	1946
North Atlantic:		
Connecticut	263	2,987
Maine and New Hampshire	27,678	36,661
Massachusetts	4	1
New York	4,809	8,123
Philadelphia	247,984	1,800,726
South Atlantic:		
Maryland	18,012	124,069
Puerto Rico		12
Virginia		173
Gulf Coast:		
Florida	94	96
Galveston	26,993	56,824
Mobile		2
New Orleans	672	96
Mexican border:		
Arizona	9	9
El Paso	52	58
Laredo	38	100
Pacific coast:		
Alaska		29
San Diego	4	15
San Francisco		103
Washington	90	3,563
Northern border:		
Buffalo	1,733,570	2,428,686
Dakota	1,857	5,167
Duluth and Superior	4,420	21,737
Michigan	804	2,119
Ohio	5,985	16,357
Rochester	247,156	182,009
St. Lawrence	1,369,191	1,815,071
Vermont	1,562	2,036
	3,691,247	6,506,829

CANADA

Coal and lignite production in Canada in 1946 increased 8 percent over 1945, and coke production declined 14 percent. Imports of anthracite, and bituminous and subbituminous coal increased 36 and 4 percent, respectively, over 1945. See table 38 for coal and coke statistics in Canada.

TABLE 38.—Coal and coke industry and foreign trade of Canada, 1945–46[1]

[Thousands of net tons]

	Coal								Coke from coal	
	Anthracite		Bituminous and subbituminous		Lignite		Total			
	1945	1946	1945	1946	1945	1946	1945	1946	1945	1946
Production			[2]14,974	16,275	1,533	1,522	16,507	17,797	3,862	3,313
Imports	3,411	4,639	21,177	22,000	(3)	(3)	24,588	26,639	1,251	909
Exports			824	854	17	9	841	863	39	47
Available for consumption	3,411	4,639	35,327	37,421	1,516	1,513	40,254	43,573	5,074	4,175

[1] Monthly Coal and Coke Statistics for Canada, December 1946. Data for 1946 are preliminary.
[2] Revised figure.
[3] Less than 1,000 tons.

WORLD PRODUCTION

Available data on world production of anthracite for 1939–46 are shown in table 39.

TABLE 39.—World production of anthracite, 1939–46, in metric tons [1]

[Compiled by P. Roberts]

Country [1]	1939	1940	1941	1942
Bulgaria	6,038	8,000	(2)	(2)
China [3]	3,633,365	5,448,464	6,532,403	7,320,664
Eire	90,455	74,170	104,871	116,290
France	9,291,000	8,036,000	8,747,000	8,963,000
Indochina, French	2,534,400	2,414,200	2,251,000	1,159,000
Italy	107,255	162,140	158,339	163,565
Korea (Chosen)	2,233,864	3,153,175	3,519,385	3,898,282
Morocco, French	115,600	143,500	139,050	119,400
Peru	3,514	4,500	4,600	5,000
Portugal	294,081	286,854	436,324	404,144
Rumania	4,409	13,724	13,533	5,125
Spain	563,963	1,095,875	1,148,332	1,242,932
Switzerland	2,500	[4] 7,000	42,385	108,096
United Kingdom	6,163,406	5,687,330	4,401,448	4,351,327
United States (Pennsylvania)	46,708,319	46,705,836	51,136,164	54,728,109
Total (estimate)	119,096,000	122,638,000	128,006,000	116,922,000

Country [1]	1943	1944	1945	1946
Bulgaria	(2)	(2)	(2)	(2)
China [3]	(2)	(2)	1,451,000	757,114
Eire	123,387	130,198	123,468	(2)
France	8,205,000	4,964,000	(2)	(2)
Indochina, French	955,000	[4] 489,700	[4] 218,000	(2)
Italy	122,075	(2)	53,446	104,989
Korea (Chosen)	4,157,101	4,530,262	(2)	[4] 1,130,000
Morocco, French	102,290	134,400	178,600	221,750
Peru	22,716	14,545	36,848	82,089
Portugal	368,321	389,638	436,117	369,333
Rumania	8,071	2,590	[4] 5,000	(2)
Spain	1,151,762	1,516,035	1,529,532	1,522,188
Switzerland	104,150	51,232	(2)	(2)
United Kingdom	4,196,671	3,652,881	3,213,405	3,582,084
United States (Pennsylvania)	55,014,679	57,788,602	49,834,944	54,890,625
Total (estimate)	117,901,000	114,039,000	105,270,000	118,168,000

[1] In addition to countries listed, Belgium, Germany, Japan, and U. S. S. R. produce anthracite, but data of output are not available. Estimates by author of chapter included in total.
[2] Data not available; estimate included in total.
[3] Excludes Kwantung Peninsula.
[4] Estimate

Cobalt

By HUBERT W. DAVIS

GENERAL SUMMARY

ALTHOUGH the demand for cobalt in 1946 was substantially less than during World War II, it was evident that the prewar peacetime upward trend in usage had projected itself into the first postwar year. In 1946, for example, industry probably consumed 60 percent more cobalt than in 1939. Because of the importance of cobalt in permanent magnets, high-temperature alloys, cutting tools, glass-metal seals, and ground-coat frit for porcelain enamel, as well as for other applications, it is expected that its peacetime demand will expand greatly. The production of cobalt before 1945 was relatively small; consequently, world output was insufficient to permit much expansion in use of this metal. During World War II, however, the capacity of mines to produce cobalt ore and of refining plants to provide metal, oxide, and other forms of cobalt was expanded phenomenally; as a result, industrialists interested in new applications are assured adequate supplies.

Taking the lead in the postwar demand for cobalt are permanent magnets and magnet steels, which took an all-time high of 1,456,522 pounds in 1946, or 10 percent more than in the previous record year 1944. Moreover, usage of cobalt for these purposes accounted for 35 percent of the total consumption in 1946. Concerning the importance of permanent magnets in modern industry, the following comment is of interest.[1]

> Probably no material has become more well known and widely used in a comparatively short period as have the Alnico series of permanent magnet alloys, produced by several concerns under license from the General Electric Co. Alnico magnets have been the means of thousands of improvements in the radio, electricity and electronics fields, and as components of machinery in a wide variety of industries and in household equipment. [General Electric Co. also produces Alnico magnets.]

The functions of permanent magnets have been grouped into four general classifications by the Indiana Steel Products Co., as follows:

1. Transformation of mechanical to electrical energy.
2. Transformation of electrical to mechanical energy.
3. Tractive effort.
4. Changing apparent characteristics of a material.

A review of permanent magnet steels, covering their metallurgy, engineering possibilities, physical qualities, and methods of fabrication, has been presented by Ruder.[2] A new permanent-magnet

[1] International Nickel Co., Inc., Nickel Steel Topics: Vol. 16, No. 1, February 1947, p. 6.
[2] Ruder, W. E., Permanent Magnet Steels: Iron Age, vol. 157, No. 19, May 9, 1946, pp. 65-69.

material—Vicalloy, an alloy of vanadium, iron, and cobalt—has been described by Nesbitt.[3] A new magnetic alloy—Hiperco, containing 35 percent cobalt, 64 percent iron, and 1 percent chromium—"that carries more magnetism than any other alloy practical for use in motors and generators and is tough enough to withstand intense vibration" has been announced.[4]

A major contribution to victory in World War II was the development of high-temperature alloys capable of maintaining strength at high operating temperatures and resisting wear, corrosion, and erosion. Informative articles on high-temperature alloys have been contributed by Knight[5] and Browne.[6] According to Knight, at least 40 high-temperature alloys, of which about 35 were designed to stand temperatures of 1,200° to 1,600° F., have been developed for various components of gas turbines, as well as in jet aircraft engines and turbosuperchargers. Of these high-temperature alloys, 13 contain cobalt ranging from 13 to 66 percent. Despite the fact that much less cobalt was employed in high-temperature alloys in 1946 than in recent years, because of their outstanding characteristics the peacetime potentialities of cobalt-base alloys appear promising. The following analyses of cobalt-base high-temperature alloys have been reported by Knight.

The quantity of cobalt employed in ground-coat frit and pigments increased sharply in 1946. The larger usage of cobalt in ground-coat frit may foretell an upward trend of substantial magnitude, inasmuch as the prefabricated-steel housing program will feature walls and built-in shelves and closets of porcelain enamel. Consequently, as the production schedule for these houses gains momentum, a corresponding increase in the demand for cobalt is anticipated.

Production of cobalt ore in the United States in 1946 declined substantially from the record established in 1945. Imports of cobalt in all forms were also much smaller than in 1945.

The consumption of cobalt contained in ore and alloy by refiners or processors in the United States was 58 percent less than in 1945, but consumption of cobalt products by industrial consumers declined only about 6 percent, owing mainly to the increased demand for cobalt for permanent magnets and magnet steel, ground-coat frit, pigments, and driers.

Effective June 12, 1946, price control over cobalt was removed by the Office of Price Administration. Despite this removal, however, metal containing 97 to 99 percent cobalt remained unchanged at the former ceiling price of $1.50 to $1.57 a pound on contract.

[3] Nesbitt, E. A., Vicalloy—A Workable Alloy for Permanent Magnets: Am. Inst. Min. and Met. Eng., Metals Technol., Tech. Pub. 1973, vol. 13, No. 2, February 1946, 11 pp.
[4] Iron Age, New Magnetic Alloy Opens Way for Lightweight Motors: Vol. 59, No. 9, Feb. 27, 1947, p. 59.
[5] Knight, H. A., Super Alloys for High-Temperature Service: Materials and Methods, vol. 23, No. 6, June 1946, pp. 1557–1563.
[6] Browne, L. E., Cobalt-Base High-Temperature Alloys: Steel, vol. 118, No. 21, May 27, 1946, pp. 88–91, 132.

Analyses of cobalt high-temperature alloys

Alloy designation	C	Mn	Si	Cr	Ni	Co	Mo	W	Fe	Others	Maker	Parts used in—
Low carbon N-155 Multimet	0.15	1.00	0.50	20.00	20.00	20.00	3.00	2.00	Bal.	N 0.14 Cb 1.00	1	Wheels, bolting, gas-turbine blades, tail cones, and ship-propulsion turbines.
Low carbon N-163	.15	1.50	.50	16.00	15.00	13.00	3.00	2.00	Bal.	N 0.14 Cb 1.00	1	(Experimental.)
S-590	.45-.40	1.50-.75	.50-.65	20.00	20.00	20.00	4.00	4.00	Bal.	Cb 4.00	2	Wheels and buckets.
S-816	.40	.50-.75	.50-.65	20.00	20.00	44.00	4.00	4.00	4.00	Cb 4.00	2	Buckets.
K-42-B	.05	.70	.40	18.00	42.00	22.00			13.00	Ti 2.00 Al 0.60	3	Turbosuperchargers, blades.
Refractalloy	.03	.70	.65	18.00	37.00	20.00	3.00		Bal.	Ti 3.00 Al 0.30	3	
Hastelloy B	.05	.60	.25		65.00	29.00			4.50		1	Buckets.
Vitallium	.30	.30	.25	27.00	2.00	64.00	5.00		2.00		4	Buckets, turbosuperchargers and jet buckets, nozzle vanes, liners, tail cones, heat exchangers.
6059	.40	.30	.25	26.00	33.00	33.00	5.00		1.00		1	
Vanadium Corp.				25.00- 35.00	20.00- 30.00	20.00- 30.00		15.00- 25.00		B 0.25- 1.00	5	
NDRC Research.												
HS-23 61 NR-60	.40-.50			28.00		Bal.		6.00			6	Blades for gas, jet engine, locomotive turbines.
HS-30 422-19 NR-12	.40-.50	.30	.25	26.00- 28.00	15.00- 16.50	49.50- 51.00	6.00		1.00		1	Blades for gas, jet engine, locomotive turbines, and hollow blades.
X-40	.40-.50			25.00- 28.00	10.00- 12.00	54.00- 55.00		7.00- 7.5	.60		6	Gas-turbine and jet-engine blades.

Maker: 1. Haynes Stellite Co. 2. Allegheny-Ludlum Steel Corp. 3. Westinghouse Electric Corp. 4. Austenal Laboratories. 5. Vanadium Corp. of America. 6. General Electric Co.

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MINE PRODUCTION AND DEVELOPMENT

Despite the fact that the United States is the largest consumer of cobalt in the world, only a small part of its requirements is furnished by domestic ore, as is evident from the next table, which shows production and shipments for 1921–44; the Bureau of Mines is not at liberty to publish figures for 1945 and 1946.

Cobalt ore produced and shipped in the United States, 1921–44 [1]

[PARTLY ESTIMATED]

Year	Produced		Shipped from mines	
	Gross weight (short tons)	Cobalt content (pounds)	Gross weight (short tons)	Cobalt content (pounds)
1921–32	93	9,300	41	5,000
1933	20	1,160		
1934	31	2,009		
1935	23	1,995		
1936	6	526		
1937	24	3,023		
1938	16	1,075		
1939	27	1,705		
1940	5,048	133,800	4,500	127,000
1941	19,127	505,377	20,031	521,627
1942	26,241	735,335	23,741	661,657
1943	27,103	732,098	28,541	763,772
1944	18,407	828,515	17,539	556,687

[1] Bureau of Mines not at liberty to publish figures for 1945 and 1946.

A complete record of the output of cobalt in the United States before 1921 is not available. Nevertheless, production has been small, and virtually all was from deposits near Fredericktown, Madison County, Mo., where a complex ore consisting of copper, lead, cobalt, and nickel has been mined sporadically. In fact, cobalt and nickel in small quantities were produced for many years preceding 1857 at the La Motte mine. Prior to 1921 attempts had been made by several companies to establish a regular production of cobalt in Missouri, and despite the fact that large sums were spent in these endeavors, none of the metallurgical processes developed for treating the complex ore proved entirely satisfactory; consequently, only spasmodic outputs were made. There was no commercial production of cobalt ore in Missouri during 1921–43. In July 1944, however, the St. Louis Smelting & Refining Co. began producing a cobalt-nickel concentrate at its property near Fredericktown and in 1945 was the chief producer in the United States. In September 1946, the company suspended the production of nickel-cobalt concentrate but is continuing to study the problem of making a successful recovery of separate products of nickel and cobalt.

Although cobalt has long been known to occur as a minor constituent of the iron ores at Cornwall, Pa., only during the past several years were experiments made on its recovery. The cobalt is contained in the sulfides that accompany the magnetite, and since 1940 there has been a regular production from this source by the Bethlehem Steel Co.

Aside from the cobalt ore produced in Missouri and Pennsylvania, there has been little other commercial production in the United States. About the middle of the nineteenth century, there was a small output

of arsenical cobalt-nickel ore in Connecticut. Oregon has been credited with spasmodic shipments of arsenical ore containing cobalt, gold, and silver; Idaho and Alabama have each produced a carlot; and Nevada has contributed 1 or 2 carlots. A small quantity of concentrate containing cobalt and nickel has been recovered as a byproduct of froth flotation of talc at Burlington, Vt. However, most of the output reported for 1921–39 represents cobalt contained in residues recovered at the electrolytic zinc plant of the Sullivan Mining Co., Kellogg, Idaho; none has been marketed.

Production and shipments of cobalt ore in the United States were much less in 1946 than in 1945; however, the Bureau of Mines is not at liberty to publish the figures for these years at this time.

The Bethlehem Steel Co. was the chief producer of cobalt ore in the United States in 1946, but its output and shipments were 20 and 1 percent, respectively, less than in 1945. The cobalt-bearing material (averaging 1.43 percent cobalt in 1946) is shipped to The Pyrites Co., Wilmington, Del., where it is processed to metal and other cobalt products.

In 1946 the St. Louis Smelting & Refining Co. produced some ore and recovered some calcines from earlier operations at its property near Fredericktown, Madison County, Mo. The cobalt material averaged 2.35 percent cobalt and was also shipped to The Pyrites Co., Wilmington, Del. Production of cobalt by the St. Louis Smelting & Refining Co. was suspended in September 1946. The company has dewatered the old workings of the mine of the Missouri Cobalt Co. near Fredericktown to determine what reserves may remain of lead and copper ores particularly but of cobalt and nickel ores as well.

The Sullivan Mining Co., Kellogg, Idaho, recovered 74 short tons of residues, containing 5,095 pounds of cobalt, at its electrolytic zinc plant in 1946. However, as in previous years, it made no shipments.

Development was continued in 1946 at the Blackbird mine near Salmon, Idaho, by the Calera Mining Co., a wholly owned subsidiary of the Howe Sound Co. Approximately 4,000 feet of drifting and crosscutting were done in 1946 with encouraging results. The ore carries copper and gold, as well as cobalt. According to the Howe Sound Co.:[7]

> Research to develop processes for the separation of the several metals included in the ore and for refining the cobalt progressed favorably. When this work is concluded a decision will be reached in regard to the size and type of plant which will be required.

CONSUMPTION

Refiners or Processors.—Consumption of cobalt contained in alloy and ore by refiners or processors was 2,009,018 pounds in 1946, a decrease of 58 percent from 1945.

Industrial Consumers.—Consumption of cobalt (exclusive of salts and driers) by industrial consumers was 3,220,027 pounds in 1946, a decrease of 13 percent from 1945. The quantity of salts and driers used is not known; but, measured by production, consumption was 958,480 pounds in 1946 compared with 728,596 pounds in 1945. Thus, it is apparent that consumption of cobalt by industrial consumers

[7] Howe Sound Co., Annual Report: 1946, p. 3.

Cobalt consumed [1] by refiners or processors in the United States, 1945–46

Cobalt material	Pounds of cobalt	
	1945	1946
Alloy and ore	4,808,825	2,009,018
Fines and granules	453,538	499,737
Hydrate	133,831	128,740
Rondelles	64,872	148,197
Carbonate	18,460	19,243

[1] The fines, granules, hydrate, rondelles, and carbonate consumed originated from alloy and ore; therefore, combining alloy and ore with these materials results in duplication.

Specified cobalt products [1] produced and shipped in the United States, 1945–46, in pounds

Product	Produced		Shipped (gross weight) [2]
	Gross weight	Cobalt content	
1945:			
January–September:			
Oxide	371,040	261,560	566,545
Hydrate	260,268	98,197	260,065
Salts and driers	8,063,341	553,243	7,816,203
October–December:			
Oxide	79,461	55,634	75,964
Hydrate	68,504	27,771	79,859
Salts:			
Acetate	59,191	13,800	63,183
Carbonate	15,425	7,549	14,026
Sulfate	33,027	6,716	17,572
Other	3,794	813	2,804
Driers	2,360,099	146,475	2,389,252
1946:			
January–June:			
Oxide	118,089	81,995	125,968
Hydrate	210,733	92,799	218,692
Salts:			
Acetate	125,728	29,610	122,320
Carbonate	80,217	38,776	82,665
Sulfate	111,850	22,562	118,985
Other	12,810	2,666	13,902
Driers	5,767,754	376,166	5,343,962
July–December:			
Oxide	110,466	77,438	102,616
Hydrate	348,850	151,567	327,600
Salts	307,077	78,717	315,777
Driers	5,821,930	409,983	6,011,881

[1] In addition, cobalt metal (rondelles, granules, fines, and powder) was produced, but the Bureau of Mines is not at liberty to publish figures on production and shipments.
[2] Comprises shipments to customers, deliveries to Office of Metals Reserve, and consumption at producing plant. Excludes sales of imported products and sales by Office of Metals Reserve.

totaled 4,178,507 pounds in 1946 compared with 4,439,483 pounds in 1945. The largest use of cobalt in 1946 was for magnets and magnet steel, which accounted for 35 percent of the total quantity consumed; usage for these purposes, moreover, established a new high and was 32 percent greater than in 1945. The second-largest quantity of cobalt was employed in stellite and stellite-type alloys, but only one-third as much was used as in 1945. The third-largest amount was employed in ground-coat frit, which used almost 2½ times more than in 1945. Consumption of cobalt in pigments and other nonmetallic purposes also was substantially greater than in 1945. The quantities of cobalt employed in cemented carbides declined conspicuously, and much less was used also in high-speed steel.

Cobalt consumed in the United States, 1943–46, by uses [1]

[EXCLUSIVE OF SALTS AND DRIERS]

Use	Pounds of cobalt			
	1943	1944	1945	1946
Metallic:				
High-speed steel	399,736	361,437	335,059	224,049
Stellite and stellite-type alloys	2,041,409	1,757,673	[2] 1,387,796	496,090
Carbide-type alloys			[2] 206,189	49,590
Magnets and magnet steel	1,032,374	1,322,097	1,105,880	1,456,522
Welding rod and stock for tipping tools	70,068	89,061	31,293	53,418
Dies and valve steel	29,604	36,865	25,566	16,104
Other	186,664	233,782	318,967	301,230
Total metallic	3,759,855	3,800,915	[2] 3,410,750	2,597,003
Nonmetallic:				
Ground-coat frit	80,504	116,884	173,428	412,766
Pigments	39,384	53,654	100,789	170,662
Other	35,415	17,459	25,920	39,596
Total nonmetallic	155,303	187,997	300,137	623,024
	3,915,158	3,988,912	[2] 3,710,887	3,220,027

[1] Comprises metal, oxide, purchased scrap, and cobalt-nickel compound, and ore used directly in magnets and other industrial applications.
[2] Revised figure.

FOREIGN TRADE [3]

Imports—Imports of cobalt into the United States in 1946 were 27 percent less than in 1945 and the smallest since 1939. The Belgian Congo continued to be the chief source of imports; in 1946 it supplied 250,112 pounds of metal and 1,648,595 pounds of alloy containing 717,337 pounds of cobalt. Belgium supplied 1,685,470 pounds of metal and 1,073,980 pounds of oxide containing about 757,200 pounds of cobalt, chiefly from Belgian Congo alloy. Canada supplied 657,787 pounds of ore containing 73,892 pounds of cobalt and the United Kingdom 650 pounds (gross weight) of oxide and 350 pounds (gross weight) of salts and compounds.

The duty on cobalt oxide continued to be 10 cents a pound, on sulfate 5 cents a pound, linoleate 10 cents, and on other cobalt salts and compounds 30 percent ad valorem. Cobalt metal and ore entered the United States duty free.

Cobalt imported for consumption in the United States, 1942–46, by classes

Year	Alloy [1]			Ore [2]		
	Pounds		Value	Pounds		Value
	Gross weight	Cobalt content		Gross weight	Cobalt content	
1942	10,313,867	4,188,687	$3,971,056	834,797	91,597	$99,898
1943	10,110,879	4,357,335	(3)	10,556,042	1,268,788	1,620,869
1944	8,500,516	3,737,000	(3)	473,529	61,123	53,434
1945	8,397,145	3,616,000	(3)	859,940	109,112	91,554
1946	1,648,595	717,337	(3)	657,787	73,892	59,861

See footnotes at end of table.

[3] Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Cobalt imported for consumption in the United States, 1942–46, by classes—Con.

Year	Metal		Oxide		Other salts and compounds	
	Pounds	Value	Pounds	Value	Pounds	Value
1942	148,304	$228,452			200	$448
1943	266,670	373,948	58,928	$95,463	56	164
1944	73,088	102,323	225,609	400,356	115	354
1945	946,475	1,582,670	120,672	215,563	224	700
1946	1,935,582	2,749,326	1,074,630	1,450,236	350	778

[1] Data for 1942 include 2,384,915 pounds of alloy, containing 980,000 pounds of cobalt and valued at $867,799, received in December 1942 but recorded as January 1943 by U. S. Department of Commerce. Data for 1943–46 reported by importer to Bureau of Mines; not separately classified by U. S. Department of Commerce.
[2] Data for 1943, 1944, and 1946 adjusted by Bureau of Mines to exclude alloy.
[3] Data not available.

Exports.—Exports of cobalt are small, as is evident from the accompanying table.

Cobalt exported from the United States, 1944–46, by classes

Class	1944		1945		1946	
	Pounds	Value	Pounds	Value	Pounds	Value
Ore and concentrates	5	$33	50	$95	1,509	$2,630
Metal and alloys	348,439	520,763	1,856	3,943	15,796	25,262
Oxide	92,031	183,158	(1)	(1)	(1)	(1)
Salts and compounds	40,046	30,488	83,041	48,835	(1)	(1)

[1] Not separately classified by U. S. Department of Commerce.

WORLD REVIEW

Despite the fact that cobalt is produced in many countries, five—Belgian Congo, Northern Rhodesia, French Morocco, the United States, and Canada—have contributed virtually the entire world output in recent years, as is apparent from the accompanying table,

World production (partly estimated) of cobalt, 1939–46, by countries, in metric tons [1]

[COMPILED BY B. B. MITCHELL]

Country [1]	Cobalt content							
	1939	1940	1941	1942	1943	1944	1945	1946
Australia	13	12	13	14	15	9	10	11
Belgian Congo	1,080	2,301	2,256	1,656	2,061	1,877	3,500	(2)
Bolivia (exports)		2	2	(3)	(3)			
Burma	[4] 229	218	73	(2)	(2)	(2)	(2)	(2)
Canada	332	360	119	38	80	16	49	34
Chile	(2)	(2)	2	(3)	3	5	1	(2)
Japan			(3)	1	3	15	11	
Morocco, French	680	330	65	3	216	243	(2)	(2)
Northern Rhodesia [4]	1,598	1,223	650	914	1943	978	874	552
United States (shipments)		58	237	300	346	253	(5)	(5)
Total (estimate)	4,200	4,800	3,700	3,300	4,100	3,800	6,000	(2)

[1] In addition to countries listed, Brazil, China, Finland, Germany, Italy, Mexico, Spain, and Sweden produce cobalt, but production data are not available.
[2] Data not available.
[3] Less than 1 ton.
[4] Year ended June 30 of year stated.
[5] Bureau of Mines not at liberty to publish figures.

which shows world production by countries, 1939–46, insofar as statistics are available.

Belgian Congo.—The world's chief source of cobalt continues to be the Belgian Congo, where the Union Minière du Haut Katanga is the sole producer. Production of cobalt in Belgian Congo was begun in 1924, when 273 metric tons were produced; since that year, output has increased almost steadily and reached a peak of 3,500 metric tons in 1945. The company has a cobalt mine and a cobalt-concentrating plant at Kabolela and a cobalt mine and ore-treatment plant at Kamoto. At Jadotville it has six single-phase electric furnaces (monthly capacity, about 300 tons) for smelting the cobalt-bearing ores and slags. The cobaltiferous red alloy from the electric furnaces is refined in two rotary furnaces; and the resultant crude cobalt, which is cast into ingots, is shipped chiefly to the United States and to Belgium, where it is processed to metal, oxide, salts, and driers. The solutions used in the electrolytic plants contain cobalt, which is recovered by a special process of precipitation. The precipitates are treated by electrolysis in a refining plant (also at Jadotville) capable of producing about 225 tons a month of granules of high purity and very low carbon content.

Canada.—Production of cobalt (content) in Canada decreased to 74,902 pounds in 1946 from 109,123 pounds in 1945. The Silanco Mining & Smelting Corp., which operates a concentrator and mines cobalt-silver ore at the Agaunico and other properties in and about Cobalt, Ontario, was the chief producer in both years. The construction of a smelter by this company, noted in the chapter of this series for 1945, was not completed in 1946.

French Morocco.—Production of cobalt ore at the Bou Azzer and Graara mines was maintained at 200 tons monthly during the first half of 1946.[9] Several hundred tons of cobalt ore have been sent from Morocco to French processing centers.[10] Moroccan ore contains nickel and gold as well as cobalt, as indicated by the following partial analyses of some shipments made to the United States in 1943.

Cobalt (percent)	Nickel (percent)	Gold (ounces per ton)	Cobalt (percent)	Nickel (percent)	Gold (ounces per ton)
15.13	1.89	3.43	12.25	1.14	2.42
14.46	1.41	1.16	14.91	2.17	5.18
12.21	1.37	1.58	11.80	1.65	2.28

Northern Rhodesia.—The second-largest producer of cobalt in the world is Northern Rhodesia, where the mineral occurs associated with copper in certain ore found in the copper mines of the Rhokana Corp.[11] The output of alloy was 1,527 short tons containing 609 tons of cobalt in the year ended June 30, 1946, compared with 2,415 tons containing 963 tons in 1945.

[9] Metal Bulletin (London), No. 3109, July 5, 1946, p. 5.
[10] Metal Bulletin (London), No. 3078, Mar. 15, 1946, p. 11.
[11] South African Mining and Engineering Journal, Production of Cobalt—Process Adopted at Nkana Mine: Vol. 54, part I, No. 2635, July 31, 1943, pp. 465, 467. See also Minerals Yearbook, 1943, pp. 648–649.

Coke and Coal Chemicals

By J. A. DE CARLO, J. A. CORGAN, AND MAXINE M. OTERO

	PAGE
General summary	400
Salient statistics	403
Statistical trends	405
Government regulations	407
Scope of report	408
Medium- and low-temperature coke	408
Retort coke	409
Oven and beehive coke and coke breeze	409
Growth of industry	409
Monthly and weekly production	411
Production by furnace and merchant plants	413
Production by States and districts	415
Number and type of ovens	416
Capacity of oven-coke plants	418
Quantity and cost of coal charged	419
Preparation and source of coal	422
Yield of coke per ton of coal	429
Oven and beehive coke and coke breeze—Continued.	
Coke breeze	430
Shipments by rail, water, and truck	431
Distribution of oven and beehive coke	432
Consumption of coke	433
Stocks of coke and coking coal	437
Value and price	439
Foreign trade	440
Technologic developments	442
World production	443
Coal-chemical materials	445
General summary	445
Coke-oven gas	450
Tar	452
Ammonia	453
Crude light oil and its derivatives	454
Naphthalene	454
Vertical-slot-type ovens owned by city gas companies	455

GENERAL SUMMARY

THE COKE INDUSTRY, an important factor in the conversion of the Nation's heavy industries from war production to peacetime operations, encountered many obstacles in 1946, and the total coke output—58,497,848 tons—represents a decrease of 13 percent from 1945 and 21 percent from the 1944 peak. The decline was due to interruptions in coking operations because of labor difficulties in the steel and bituminous-coal industries. The 4-week steel strike beginning on January 21, 1946, caused the rate of coke production at oven plants connected with iron and steel works to decline from 82.1 percent of capacity in December 1945 to a low of 36.3 percent in February 1946. During this period beehive-coke ovens could not ship their coke to steel plants and in seeking other markets exported such large quantities that monthly exports in the first 2 months of 1946 were the highest on record. Nonfurnace or merchant oven plants were not directly affected by the stoppage and operated at 90 percent of capacity in this period. Settlement of the steel strike started the flow of coke to blast furnaces, and in March the average daily production of beehive and oven coke increased 64 per-

cent over the February figure; but, with stoppages in the bituminous-coal industry in April and May, the output of oven coke dropped sharply from the March rate, and beehive production declined to the lowest point since May 1939. Settlement of the coal strike on

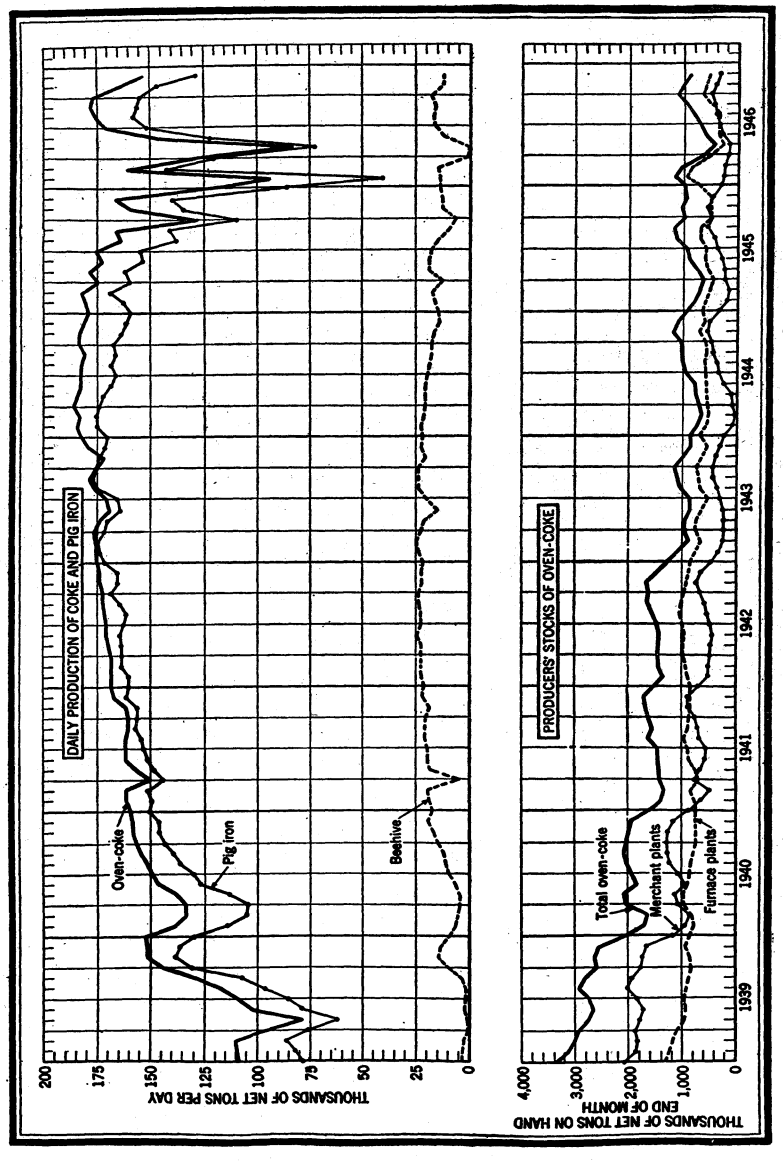

FIGURE 1.—Average daily production of beehive and oven coke and pig iron and producers' stocks of oven coke, 1939–46, by months.

May 29 caused production to increase steadily until November 21, when the bituminous-coal miners walked out again, forcing oven-coke operators to slow their coking schedules and practically closing all beehive plants until the strike ended on December 7.

These interruptions in plant operations necessarily reduced the consumption of coking coal, and 13 percent less was charged into the ovens than in 1945. Although requirements of coking coal in 1946 were lower than in the previous year, supplies of high-grade coking coals were extremely limited throughout the year. The Solid Fuels Administration, in order to distribute the available coal equitably and prevent the shut-down of essential industrial operations, issued a number of emergency distribution regulations and "freeze" orders in 1946. Coal was allocated widely during the coal and transportation strikes, and emergency regulations were used for the latest time during the coal strike in November-December. The Bureau of Mines cooperated closely with the Solid Fuels Administration in collecting and compiling statistical data relating to requirements, consumption, stocks, and days' supply of coking coal at individual oven-coke plants.

General increases in mining and transportation costs in 1946 caused the average value of coking coal delivered to coke plants to rise $0.45 per ton over 1945, a gain of nearly 9 percent. The average values of $5.77 and $3.59 per ton for coal delivered to oven- and beehive-coke plants, respectively, were the highest on record.

To meet the tremendous wartime demand for coke and coal-chemical materials, the oven-coke industry increased its annual coke capacity more than 11,700,000 tons, or 20 percent, between 1940 and 1946. The coke capacity of beehive ovens, which increased about 1 million tons a year during the early phases of the war in order to supplement oven-coke output, dropped sharply after the close of the war but increased in 1946 because of the extremely heavy demand for industrial coke. Indications in the first half of 1947 point to a substantial increase in capacity and production of beehive coke during 1947.

The disposal pattern of coke in 1946 followed, in general, that of 1945, blast furnaces accounting for 75 percent of the total consumption; iron foundries, 5 percent; the manufacture of producer gas and water gas, 7 percent; other industrial purposes, 4 percent; and domestic coke sales, 9 percent. Sales of coke for domestic heating declined greatly from 1945 and equaled only 62 percent of the 1940 figure.

According to data compiled by the Bureau of Mines from records of the United States Department of Commerce, exports of coke to foreign countries declined 17 percent from 1945. Although exports in the first quarter of 1946 during the steel strike were unusually high, shipments in the last three quarters dropped sharply in order that requirements in this country might be met. As in previous years, imports were small, representing less than 0.1 percent of the total consumption.

Coke prices in general followed the rise in coal and labor costs. The average increases in the price per ton of coke sold by producers (merchant sales) in 1946 were as follows: Furnace coke, $0.84; foundry coke, $1.03; coke used in the manufacture of water gas, $1.37; other industrial, $1.05; and domestic coke, $1.19.

Total year-end stocks of coke at producing plants in 1946 were 928,766 tons, a slight decrease from the 1945 total. Stocks of furnace coke increased 48,620 tons, but foundry and domestic coke reserves dropped 10,706 and 40,961 tons, respectively.

TABLE 1.—Salient statistics of the coke industry in the United States in 1946

	Vertical slot-type ovens	Beehive ovens	Total
Coke produced—			
At merchant plants:			
Net tons	12,388,485	(1)	(1)
Value	$122,963,480		
At furnace plants:			
Net tons	41,540,962		
Value	$327,096,732		
Total:			
Net tons	53,929,447	4,568,401	58,497,848
Value	$450,060,212	$36,669,170	$486,729,382
Screenings or breeze produced:			
Net tons	4,232,252	76,015	4,308,267
Value	$11,717,566	$113,796	$11,831,362
Coal charged into ovens:			
Bituminous:			
Net tons	76,120,674	7,167,424	83,288,098
Value	$439,292,647	$25,722,680	$465,015,327
Average per ton	$5.77	$3.59	$5.58
Anthracite:			
Net tons	238,812		238,812
Value	$1,250,853		$1,250,853
Average per ton	$5.24		$5.24
Total:			
Net tons	76,359,486	7,167,424	83,526,910
Value	$440,543,500	$25,722,680	$466,266,180
Average per ton	$5.77	$3.59	$5.58
Average yield in percent of total coal charged:			
Coke	70.63	63.74	70.03
Breeze (at plants actually recovering)	5.54	2.92	5.46
Ovens:			
In existence January 1	14,510	12,179	26,689
In existence December 31	14,494	12,864	27,358
Dismantled during year	100	11	111
In course of construction December 31	824		824
Annual coke capacity December 31 net tons	71,112,600	8,427,000	79,539,600
Coke used by producer—			
In blast furnaces:			
Net tons	29,705,380	51,367	29,756,747
Value	$242,177,121	$581,918	$242,759,039
In foundries:			
Net tons	68,539		68,539
Value	$669,345		$669,345
To make producer gas:			
Net tons	801,353		801,353
Value	$5,956,376		$5,956,376
To make water gas:			
Net tons	1,429,785		1,429,785
Value	$11,012,922		$11,012,922
For other purposes:			
Net tons	352,273	1,079	353,352
Value	$2,914,160	$10,770	$2,924,930
Coke sold—			
To financially affiliated plants—			
For blast-furnace use:			
Net tons	8,791,275	1,210,447	10,001,722
Value	$57,666,275	$8,278,178	$65,944,453
For foundry use:			
Net tons	2,344		2,344
Value	$16,213		$16,213
For manufacture of water gas:			
Net tons	583,904		583,904
Value	$5,230,353		$5,230,353
For other purposes:			
Net tons	186,906	53,939	240,845
Value	$1,585,360	$549,481	$2,134,841
To other consumers—			
For blast-furnace use:			
Net tons	1,909,401	2,032,622	3,942,023
Value	$16,892,654	$16,475,820	$33,368,474
For foundry use:			
Net tons	2,571,324	353,995	2,925,319
Value	$32,441,337	$3,302,073	$35,743,410

See footnotes at end of table.

TABLE 1.—Salient statistics of the coke industry in the United States in 1946—Continued

	Vertical slot-type ovens	Beehive ovens	Total
Coke sold—Continued.			
To other consumers—Continued.			
For manufacture of water gas:			
Net tons	942,837	190,438	1,133,275
Value	$9,198,354	$1,652,029	$10,850,383
For other industrial use:			
Net tons	1,557,830	493,526	2,051,356
Value	$14,758,195	$4,281,119	$19,039,314
For domestic use:			
Net tons	4,947,085	149,648	5,096,733
Value	$48,977,854	$1,186,250	$50,164,104
Disposal of screenings or breeze:			
Used by producer—			
For raising steam:			
Net tons	3,134,177	6,384	3,140,561
Value	$8,454,978	$14,683	$8,469,661
To make producer or water gas:			
Net tons	45,806		45,806
Value	$164,015		$164,015
For other purposes:			
Net tons	551,155	21	551,176
Value	$1,417,482	$165	$1,417,647
Sold:			
Net tons	1,023,587	41,967	1,065,554
Value	$3,049,084	$58,388	$3,107,472
Average receipts per ton sold (merchant sales):			
Furnace coke	$8.85	$8.11	$8.46
Foundry coke	$12.62	$9.33	$12.22
Water gas coke	$9.76	$8.67	$9.57
Other industrial coke	$9.47	$8.67	$9.28
Domestic coke	$9.90	$7.93	$9.84
Screenings or breeze	$2.98	$1.39	$2.92
Stocks on January 1, 1947:			
Furnace coke—net tons	445,763	30,750	476,513
Foundry coke—do	12,565	1,508	14,073
Domestic and other coke—do	434,585	3,595	438,180
Screenings or breeze—do	712,252	2,971	715,223
Exports—do	[1]	[1]	1,231,327
Imports—do	[1]	[1]	52,188
Indicated consumption—do	[1]	[1]	57,321,756
Coal-chemical materials produced:			
Tar—gallons	596,868,745		596,868,745
Ammonium sulfate or equivalent—pounds	1,487,434,225		1,487,434,225
Gas—M cubic feet	783,637,016		783,637,016
Burned in coking process—percent	37.48		37.48
Surplus sold or used—do	61.32		61.32
Wasted—do	1.20		1.20
Crude light oil—gallons	206,914,333		206,914,333
Yield of coal-chemical materials per ton of coal:			
Tar—do	7.82		7.82
Ammonium sulfate or equivalent—pounds	19.79		19.79
Gas—M cubic feet	10.26		10.26
Crude light oil—gallons	2.77		2.77
Value of coal-chemical materials sold:			
Tar:			
Sold	$21,284,137		$21,284,137
Use by producer	$3,837,895		$3,837,895
Ammonium sulfate or equivalent	$19,442,059		$19,442,059
Gas (surplus)	$83,184,679		$83,184,679
Crude light oil and derivatives	$23,581,473		$23,581,473
Other coal-chemical materials [2]	$9,897,527		$9,897,527
Total value of coke and breeze produced and coal-chemical materials sold [3]	$623,005,548	$36,782,966	$659,788,514

[1] Not separable.
[2] Includes naphthalene, tar derivatives, and miscellaneous coal-chemical materials.
[3] Includes value of tar used by producer.

Preliminary data from the Bureau's annual survey of employment at coke plants revealed that, in 1946, 18,700 men were employed at oven-coke plants and worked 53,350,000 man-hours, reductions from 1945 of 1,754 men and 5,942,507 man-hours. The number of men

employed at beehive plants increased from 2,533 in 1945 to 2,800 in 1946 but the man-hours worked decreased from 5,082,575 to 4,550,000. Several plants that had been idle for some months resumed operations in the latter part of 1946, accounting for the increased number of men employed.

The effect of reduced output of coke was reflected all through the basic coal-chemical materials and further into the derivatives of tar and light oil. Production of crude tar decreased 14 percent from 1945; ammonia (NH_3 equivalent of all forms), 15 percent; crude light oil, 16 percent; and coke-oven gas, 13 percent. The total value realized through the sales of all coal-chemical materials at producing plants decreased only 9 percent from 1945 to $157,389,875 chiefly because of price increases for gas, tar, and ammonium sulfate. The value of all coke, breeze, and coal-chemical materials in 1946 was $659,788,514, a 6-percent decrease from 1945.

TABLE 2.—Statistical trends of the coke industry in the United States, 1937 and 1943–46

	1937	1943	1944	1945	1946
Production:					
Oven coke—net tons	49,210,748	63,742,676	67,064,795	62,094,288	53,929,447
Beehive coke—do	3,164,721	7,933,387	6,973,022	5,213,893	4,568,401
Total—do	52,375,469	71,676,063	74,037,817	67,308,181	58,497,848
Percent from vertical slot-type ovens	94.0	88.9	90.6	92.3	92.2
Stocks of coke, end of year—net tons	2,595,287	862,100	1,124,685	931,813	928,766
Exports, all coke—do	526,683	994,607	866,835	1,478,746	1,231,328
Imports, all coke—do	286,364	98,127	63,004	51,964	52,188
Indicated consumption, all coke—do	51,271,929	71,406,532	72,971,401	66,074,271	57,321,756
Disposal, all coke sold or used:					
Furnace coke—do	36,751,969	57,690,160	57,481,353	51,002,921	43,700,492
Foundry coke—do	2,038,822	2,606,889	2,511,854	2,636,731	2,996,202
Other industrial coke (including producer and water gas)—net tons	4,597,894	6,999,884	6,978,062	6,937,553	6,593,870
Domestic coke—do	8,107,518	4,885,528	6,717,543	6,775,508	5,096,733
Ovens:					
Vertical slot type in existence, end of year	12,718	14,253	14,580	14,510	14,494
Beehive in existence, end of year	12,194	17,666	16,318	12,179	12,864
Vertical slot type under construction, end of year	259	528	180	335	824
Cost of coal charged, vertical slot-type ovens, average per ton	$3.74	$4.75	$5.08	$5.28	$5.77
Prices of coke:					
Average spot price of Connellsville furnace coke, f. o. b. ovens	$4.29	$6.46	$7.00	$7.29	$8.13
Average realization on oven coke sold (merchant sales):					
Furnace coke	$4.34	$7.26	$7.59	$7.87	$8.85
Foundry coke	$8.47	$10.17	$11.03	$11.48	$12.62
Other industrial coke (including water gas)	$6.08	$7.43	$8.12	$8.35	$9.58
Domestic coke	$6.53	$8.21	$8.63	$8.69	$9.90
Yield of coal-chemical materials per ton of coal charged:					
Tar—gallons	8.67	8.11	8.13	7.95	7.82
Ammonium sulfate or equivalent—pounds	21.84	20.32	20.29	20.22	19.79
Crude light oil—gallons	2.86	2.83	2.87	2.84	2.77
Surplus gas sold or used—M cubic feet	6.66	6.59	6.58	6.33	6.29
Average gross receipts for coal-chemical materials per ton of coke produced:					
Tar sold and used	$0.502	$0.463	$0.458	$0.447	$0.466
Ammonia and its compounds	$0.326	$0.355	$0.324	$0.356	$0.361
Crude light oil and its derivatives (including naphthalene)	$0.435	$0.546	$0.552	$0.503	$0.467
Surplus gas sold or used	$1.483	$1.390	$1.403	$1.413	$1.542
Total coal-chemical materials (including breeze)	$2.974	$3.123	$3,102	$3,069	$3.207

TABLE 3.—Coke produced, value, number of ovens, coal charged, and average yield in the United States in 1946, by States

[Exclusive of screenings or breeze]

State	Oven coke							Beehive coke						Total	
	Plants	Ovens	Coal charged (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens		Ovens	Coal charged (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens		Coke produced (net tons)	Value of coke at ovens
						Total	Per ton					Total	Per ton		
Alabama	7	1,490	6,530,336	71.45	4,665,939	$32,669,886	$7.00							4,665,939	$32,669,886
California	1	90	420,297	61.97	260,470	(1)	(1)							260,470	(1)
Colorado	1	188	832,415	67.10	558,545	(1)	(1)	160	90,831	64.69	58,761	(1)	(1)	617,306	(1)
Illinois	[2] 9	856	4,505,323	70.86	3,192,395	32,241,972	10.10							3,192,395	32,241,972
Indiana	5	1,863	9,198,959	72.31	6,651,567	59,312,827	8.92							6,651,567	59,312,827
Maryland	1	422	2,296,212	72.36	1,661,606	(1)	(1)							1,661,606	(1)
Massachusetts	2	215	1,497,347	69.87	1,046,267	(1)	(1)							1,046,267	(1)
Michigan	4	568	3,471,559	72.00	2,499,664	26,191,476	10.48							2,499,664	26,191,476
Minnesota	3	196	1,192,679	72.17	860,754	8,468,220	9.84							860,754	8,468,220
New Jersey	2	304	1,738,942	72.39	1,258,854	(1)	(1)							1,258,854	(1)
New York	8	1,142	7,108,999	70.93	5,042,674	44,316,777	8.79							5,042,674	44,316,777
Ohio	15	2,099	11,924,954	70.87	8,451,580	69,357,225	8.21							8,451,580	69,357,225
Pennsylvania	13	3,564	18,597,362	68.80	12,794,721	90,189,945	7.05	10,547	6,285,177	64.07	4,027,167	$31,627,135	$7.85	16,821,888	121,817,080
Tennessee	1	44	314,340	73.09	229,751	(1)	(1)							229,751	(1)
Texas		125													
Utah	2	308	807,594	60.32	487,133	(1)	(1)	297	11,553	45.30	5,234	(1)	(1)	492,367	(1)
West Virginia	5	506	3,072,457	70.38	2,162,453	12,190,707	5.64	750	291,852	58.67	171,242	1,619,144	9.46	171,242	1,619,144
								915	354,489	62.23	220,597	1,913,713	8.68	2,383,050	14,104,420
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	6	514	2,849,711	73.87	2,105,074	21,026,086	9.99	195	133,522	63.96	85,400	(1)	(1)	2,190,474	(1)
Undistributed						54,095,091	9.83					1,509,178	10.10		76,630,355
Total: 1946	85	14,494	76,359,486	70.63	53,929,447	450,060,212	8.35	12,864	7,167,424	63.74	4,568,401	36,669,170	8.03	58,497,848	486,729,382
1945	87	14,510	87,536,764	70.94	62,094,288	470,190,339	7.57	12,179	8,134,629	64.10	5,213,893	38,349,703	7.36	67,308,181	508,540,042

[1] Included under "Undistributed."
[2] 1 plant closed down in August.

GOVERNMENT REGULATIONS

The Solid Fuels Administration for War in February 1946 announced that after April 1, 1946, producers, distributors, and consumers of special-purpose coals would be free to make agreements and that the filing of contracts with the Administration was no longer required. The statement stipulated, however, that after April 1, 1946, SFAW would continue to exercise its authority to issue specific emergency directions under Regulation 1.

Work stoppages in the bituminuous-coal industry in the spring and fall of 1946 created a shortage of coal, and the SFAW issued certain specific "freeze" orders and emergency regulations in order to distribute equitably supplies of coal available. Following the end of the coal strike in December, SFAW modified its distribution rules in an interim direction, effective December 8, 1946, which, among other provisions, set up a preference listing of essential users of bituminous coal and domestic coke. Steel plants were not included in any of the preference groups.

The 4-week steel strike in the early part of 1946 curtailed the output of coke drastically at integrated coke and steel plants and intensified the shortage of coke. This condition prompted the Civilian Production Administration to issue Direction 10 to Priorities Regulation 32 on April 2, 1946. This direction limited coke inventories of any person (including a Government establishment) to a 20 days' supply. The coal strike in the fall forced coke operators to curtail their operations, and CPA again limited not only inventories but also deliveries of coke made from bituminous coal.

Ceiling prices on beehive and oven coke were raised in 1946 by the Office of Price Administration to compensate producers for increased manufacturing costs resulting from advances in coal prices and in wages. Adjustable pricing by producers of oven and beehive coke was authorized by OPA on May 16 and 31, respectively, in Order 21 to MPR 29 and Order 18 to MPR 77. This action was taken to permit producers to enter into price agreements until the effect on the price of coke of the new increases in coal prices and in wages could be determined accurately. Following completion of the study by OPA on the effects of the increased coal costs, maximum prices of oven coke were increased $1.35 per ton, effective June 28, 1946, and on August 22, 1946, beehive coke produced in the Connellsville district[1] were increased $1.35 per ton for hand-drawn coke and $1.25 per ton for machine-drawn coke.

On June 13, 1946, OPA issued Amendment 3 to MPR 447, which provided for an increase in the price of tar to producers where it could be shown that tar was being diverted from distillers and used as a fuel by the producer because of the price differential between fuel oil and tar.

All controls over prices on coal, coke, and related products were abolished by OPA Supplementary Order 193, effective November 10, 1946.

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[1] Western Pennsylvania and Barbour, Monongalia, Preston, and Upshur Counties, W. Va.

SCOPE OF REPORT

This chapter is based on data supplied to the Bureau of Mines by coke-plant operators in the United States. The terms designating certain kinds of coke and related products have been revised in this report to agree with terminology embodied in present-day trade practices. The term "oven coke" is used when referring to the solid material formerly called "byproduct coke" which is produced in high-temperature, vertical slot-type coke ovens; coke produced in beehive ovens is referred to as "beehive coke" and coke produced in coal-gas retorts as "retort coke." The gaseous and liquid materials formerly called "byproducts" are designated as "coal-chemical materials." These changes do not affect the statistical information in this report in any way, and it is therefore comparable to that issued in previous years. The statistics throughout the principal part of this report are confined to oven and beehive coke. Salient statistics on low- and medium-temperature carbonization are shown separately in table 4 and similar data for retort coke in table 5. Coke is also made by other processes not included in this report, including the refining of petroleum and of crude tar. Preliminary figures for 1946 indicate that the production of petroleum coke and coal-tar-pitch coke was 2,124,200 and 92,000 tons, respectively. The standard unit of measurement in the coke industry in the United States is the short or net ton of 2,000 pounds; unless otherwise specified, it is the unit employed throughout this chapter.

MEDIUM- AND LOW-TEMPERATURE COKE

TABLE 4.—Salient statistics of medium- and low-temperature carbonization plants in the United States in 1946

	Quantity	Value
Coke produced ..... net tons	131,194	$1,079,479
Screenings or breeze produced ..... do	14,490	21,011
Coal carbonized ..... do	230,797	689,803
Average per ton	----------	2.99
Average yield in percent of coal carbonized:		
Coke	56.84	----------
Breeze	8.75	----------
Ovens and retorts:		
In existence Dec. 31	31	----------
Annual coke capacity Dec. 31 ..... net tons	190,100	----------
Tar produced ..... gallons	1,931,688	----------
Yield per ton of coal ..... do	8.37	----------
Value of coke and breeze produced and coal-chemical materials sold	----------	1,344,411

RETORT COKE

TABLE 5.—Salient statistics of the coal-gas industry in the United States in 1946 [1]

	Horizontal retorts	Vertical retorts and gas ovens	Total
Coke produced:			
Net tons	278,170	475,165	753,335
Value	$2,446,619	$4,183,102	$6,629,721
Screenings or breeze produced, net tons	28,100	68,719	96,819
Coal charged into retorts:			
Net tons	456,421	783,694	1,240,115
Value	$3,478,003	$5,696,959	$9,174,962
Average per ton	$7.62	$7.27	$7.40
Average yield in percent of coal charged:			
Coke	60.95	60.63	60.75
Breeze (at plants actually recovering)	8.90	9.13	9.06
Retorts:			
In existence December 31	1,559	[2] 589	2,148
In operation December 31	1,205	[2] 582	1,787
Annual coal capacity, net tons	652,100	956,400	1,608,500
Coke used by producer:			
Net tons	168,449	212,632	381,081
Value	$1,381,901	$1,729,741	$3,111,642
Coke sold to other consumers:			
Net tons	120,950	267,395	388,345
Value	$1,139,256	$2,504,414	$3,643,670
Stocks on January 1, 1947:			
Coke, net tons	19,636	49,583	69,219
Breeze, do	4,395	14,407	18,802
Coal chemical materials:			
Tar:			
Production, gallons	5,555,805	11,908,587	17,464,392
Sales, do	6,202,302	12,134,739	18,337,041
Value of sales	$285,244	$599,077	$884,321
Stocks on January 1, 1947, gallons	1,219,058	1,338,598	2,557,656
Per ton of coal charged, do	12.17	15.20	14.08
Ammonia liquor (NH_3 content):			
Production, pounds		1,259,469	1,259,469
Sales, do		1,268,254	1,268,254
Value of sales		$31,703	$31,703
Stocks on January 1, 1947, pounds		110,238	110,238
Per ton of coal charged, do		3.52	3.52

[1] Additional data in Production of Coke and Coal Chemical Materials from Coal-gas Retorts in 1946, Bureau of Mines Mineral Market Report 1516, May 12, 1947.
[2] Includes 15 gas ovens.

OVEN AND BEEHIVE COKE AND COKE BREEZE

GROWTH OF INDUSTRY

TABLE 6.—Historical statistics of coke industry in the United States, 1880 and 1890–1946

Year	Production (million net tons): Oven coke	Beehive coke	Total	Percent of total production from slot-type ovens	Ovens in existence: Slot type	Beehive	Slot-type ovens under construction at end of year	Coal charged (million net tons)	Yield of coke from coal (percent)	Average value of coke per ton at plant	Total value at plant (million dollars): Beehive coke	Oven coke	All coal-chemical materials [1]	Total coke and coal-chemical materials
1880	------	3.3	3.3	------	------	12,372	------	5.2	63.7	$1.99	7	------	------	7
1890	------	11.5	11.5	------	------	37,158	------	18.0	63.9	2.02	23	------	------	23
1891	------	10.4	10.4	------	------	40,057	------	16.3	63.3	1.97	20	------	------	20
1892	------	12.0	12.0	------	------	42,002	------	18.8	63.8	1.96	24	------	------	24
1893	0.01	9.5	9.5	0.1	12	44,189	------	14.9	63.5	1.74	17	------	[2]	[2]
1894	.02	9.2	9.2	.2	12	44,760	60	14.4	64.0	1.34	12	------	[2]	[2]
1895	.02	13.3	13.3	.1	72	45,493	60	20.8	64.0	1.44	19		[2]	[2]
1896	.1	11.7	11.8	.7	160	46,784	120	18.7	63.1	1.84	22		[2]	[2]

See footnotes at end of table.

TABLE 6—Historical statistics of coke industry in the United States, 1880 and 1890–1946—Continued

Year	Production (million net tons): Oven coke	Beehive coke	Total	Percent of total production from slot-type ovens	Ovens in existence: Slot type	Beehive	Slot-type ovens under construction at end of year	Coal charged (million net tons)	Yield of coke from coal (percent)	Average value of coke per ton at plant	Total value at plant (million dollars): Beehive coke	Oven coke	All coal-chemical materials [1]	Total coke and coal-chemical materials
1897	0.3	13.0	13.3	2.0	280	47,388	240	20.9	63.6	$1.66		22	(2)	(2)
1898	.3	15.7	16.0	1.8	520	47,863	500	25.2	63.6	1.59		26	(2)	(2)
1899	.9	18.8	19.7	4.6	1,020	48,583	65	30.2	65.1	1.76		35	(2)	(2)
1900	1.1	19.4	20.5	5.2	1,085	57,399	1,096	32.1	63.9	2.31		47	(2)	(2)
1901	1.2	20.6	21.8	5.4	1,165	62,786	1,533	34.2	63.7	2.04		44		
1902	1.4	24.0	25.4	5.5	1,663	67,406	1,346	39.6	64.1	2.49		63	(2)	(2)
1903	1.9	23.4	25.3	7.4	1,956	77,378	1,335	39.4	64.1	2.63		66	(2)	(2)
1904	2.6	21.1	23.7	11.0	2,910	80,689	832	36.5	64.8	1.95		46	(2)	(2)
1905	3.4	28.8	32.2	10.7	3,103	84,405	417	49.5	65.1	2.25		72	(2)	(2)
1906	4.6	31.8	36.4	12.5	3,547	90,354	112	55.7	65.3	2.52		92	(2)	(2)
1907	5.6	35.2	40.8	13.8	3,684	95,996	330	61.9	65.8	2.74	90	22	8	120
1908	4.2	21.8	26.0	16.1	3,799	97,419	240	39.4	66.0	2.40	48	14	7	69
1909	6.2	33.1	39.3	15.9	3,989	99,993	949	59.4	66.2	2.29	70	20	8	98
1910	7.1	34.6	41.7	17.1	4,078	100,362	1,200	63.1	66.1	2.39	75	25	8	108
1911	7.9	27.7	35.6	22.1	4,624	99,255	698	53.3	66.7	2.37	57	27	10	94
1912	11.1	32.9	44.0	25.3	5,211	97,019	793	65.6	67.1	2.54	69	43	14	126
1913	12.7	33.6	46.3	27.5	5,688	96,962	504	69.2	66.9	2.78	80	49	17	146
1914	11.2	23.4	34.6	32.5	5,809	93,946	644	51.6	66.9	2.56	50	38	18	106
1915	14.1	27.5	41.6	33.8	6,268	93,110	1,191	61.8	67.2	2.54	57	49	30	136
1916	19.1	35.4	54.5	35.0	7,283	91,581	2,084	81.6	66.8	3.13	96	75	62	233
1917	22.4	33.2	55.6	40.4	7,869	88,027	2,260	83.8	66.4	5.36	159	139	68	366
1918	26.0	30.5	56.5	46.0	9,279	84,635	1,815	85.0	66.4	6.77	189	193	77	459
1919	25.1	19.1	44.2	56.9	10,379	82,560	877	65.6	67.4	5.85	98	160	68	326
1920	30.8	20.5	51.3	60.0	10,881	75,298	396	76.2	67.4	9.27	163	313	105	581
1921	19.8	5.5	25.3	78.1	11,142	66,014	85	37.2	68.0	5.84	30	118	68	216
1922	28.5	8.6	37.1	76.9	11,212	63,958	403	54.3	68.3	6.42	50	188	95	333
1923	37.6	19.4	57.0	66.0	11,156	62,349	629	84.4	67.5	6.56	116	257	131	504
1924	34.0	10.3	44.3	76.8	11,413	60,432	247	65.0	68.1	5.51	48	196	120	364
1925	39.9	11.4	51.3	77.9	11,290	57,587	429	74.5	68.8	5.12	52	211	143	406
1926	44.4	12.5	56.9	78.0	11,716	52,558	978	82.9	68.6	5.41	57	251	157	465
1927	43.9	7.2	51.1	85.9	12,475	49,795	289	74.4	68.6	5.13	30	232	160	422
1928	48.3	4.5	52.8	91.5	12,544	41,288	145	77.2	68.4	4.79	16	237	177	430
1929	53.4	6.5	59.9	89.2	12,649	30,082	408	86.8	69.0	4.66	23	256	192	471
1930	45.2	2.8	48.0	94.2	12,831	23,907	276	69.8	68.7	4.36	10	200	168	378
1931	32.4	1.1	33.5	96.6	13,108	21,588	-------	48.6	68.9	4.83	4	158	125	287
1932	21.1	.7	21.8	97.0	13,053	19,440	-------	31.9	68.3	4.79	2	103	88	193
1933	26.7	.9	27.6	96.7	13,053	16,857	-------	40.1	68.7	4.46	3	120	95	218
1934	30.8	1.0	31.8	96.8	12,963	14,206	-------	46.0	69.2	5.01	4	155	104	263
1935	34.2	.9	35.1	97.4	12,860	13,674	122	50.5	69.6	5.03	4	173	113	290
1936	44.6	1.7	46.3	96.3	12,849	13,012	305	65.9	70.2	5.02	7	226	136	369
1937	49.2	3.2	52.4	94.0	12,718	12,194	259	74.5	70.3	4.98	14	247	151	412
1938	31.7	.8	32.5	97.4	12,724	10,816	146	46.6	69.7	5.14	4	163	116	283
1939	42.9	1.4	44.3	96.7	12,732	10,934	-------	63.5	69.8	4.80	6	207	142	355
1940	54.0	3.1	57.1	94.6	12,734	15,150	492	81.4	70.1	4.80	14	260	168	442
1941	58.5	6.7	65.2	89.7	13,016	18,669	181	93.1	70.0	5.41	37	316	183	536
1942	62.3	8.3	70.6	88.3	13,303	16,295	1,327	100.8	70.0	6.03	47	378	204	629
1943	63.8	7.9	71.7	88.9	14,253	17,666	528	102.5	70.0	6.64	52	424	210	686
1944	67.0	7.0	74.0	90.6	14,580	16,318	180	105.3	70.3	7.13	49	479	208	736
1945	62.1	5.2	67.3	92.3	14,510	12,179	335	95.7	70.4	7.56	38	470	191	699
1946	53.9	4.6	58.5	92.2	14,494	12,864	824	83.5	70.0	8.32	37	450	173	660

[1] Value for tar up to and including 1917 represented that of tar "obtained and sold," which did not always include value of tar used by producer. Beginning with 1918, tar used by producer is specifically included. Value of breeze produced at over-coke plants is included for those years for which it was reported, namely, 1916, 1917, and 1919–46. For other coal-chemical materials, only value of those sold is included. Value of breeze produced at beehive plants is not included, as it has usually been much less than a million dollars.

[2] No accurate data on value of the coal-chemical materials available.

MONTHLY AND WEEKLY PRODUCTION

Tables 7 to 10 summarize weekly and monthly production of coke. Weekly production of beehive coke is estimated from records of carloadings received each week from all coke-carrying railroads. Monthly data on beehive and oven coke are based upon reports from producers. The weekly and monthly figures have been adjusted to the annual total ascertained by direct canvass of the producers.

TABLE 7.—Coke produced in the United States, 1937 and 1944–46, by months and average per day, in net tons [1]

Month	1937		1944		1945		1946	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
Oven coke:								
January	4,360,700	140,700	5,663,400	182,700	5,621,100	181,300	3,822,300	123,300
February	3,992,900	142,600	5,360,800	184,900	5,101,000	182,200	2,647,200	94,500
March	4,495,500	145,000	5,692,800	183,700	5,691,100	183,600	5,029,700	162,200
April	4,350,900	145,000	5,581,700	186,000	5,269,200	175,600	3,874,800	129,200
May	4,479,700	144,500	5,728,000	184,800	5,572,900	179,800	2,588,900	83,500
June	4,024,800	134,200	5,472,800	182,400	5,207,500	173,600	4,444,400	148,100
July	4,423,900	142,700	5,663,800	182,700	5,473,700	176,600	5,354,500	172,700
August	4,573,400	147,500	5,670,300	182,900	5,111,300	164,900	5,494,600	177,300
September	4,427,800	147,600	5,412,300	180,400	5,036,900	167,900	5,376,500	179,200
October	4,035,100	130,200	5,671,900	183,000	3,974,100	128,200	5,545,200	178,900
November	3,222,300	107,400	5,507,300	183,600	4,827,900	160,900	4,954,300	165,100
December	2,823,800	91,100	5,639,700	181,900	5,207,600	168,000	4,797,000	154,700
	49,210,800	134,800	67,064,800	183,200	62,094,300	170,100	53,929,400	147,800
Beehive coke:								
January	274,300	10,600	679,900	21,900	460,700	14,900	418,500	13,500
February	294,600	12,300	644,200	22,200	456,000	16,300	379,400	13,600
March	357,300	13,200	667,600	21,500	534,800	17,200	478,200	15,500
April	309,700	11,900	614,500	20,500	377,000	12,600	22,100	700
May	326,500	12,600	645,300	20,800	559,900	18,000	27,800	900
June	274,800	10,600	614,900	20,500	561,000	18,700	377,900	12,600
July	285,100	11,000	605,100	19,500	550,800	17,700	482,800	15,600
August	259,000	10,000	572,500	18,500	456,400	14,700	539,900	17,400
September	253,900	9,800	516,200	17,200	297,800	9,900	500,100	16,700
October	225,500	8,700	526,700	17,000	198,100	6,400	573,900	18,500
November	168,800	6,500	481,200	16,000	367,700	12,300	372,100	12,400
December	135,200	5,200	404,900	13,100	393,700	12,700	395,700	12,800
	3,164,700	10,200	6,973,000	19,100	5,213,900	14,300	4,568,400	12,500
Total:								
January	4,635,000	151,300	6,343,300	204,600	6,081,800	196,200	4,240,800	136,800
February	4,287,500	154,900	6,005,000	207,100	5,557,000	198,500	3,026,600	108,100
March	4,852,800	158,200	6,360,400	205,200	6,225,900	200,800	5,507,900	177,700
April	4,660,600	156,900	6,196,200	206,500	5,646,200	188,200	3,896,900	129,900
May	4,806,200	157,100	6,373,300	205,600	6,132,800	197,800	2,616,700	84,400
June	4,299,600	144,800	6,087,700	202,900	5,768,500	192,300	4,822,300	160,700
July	4,709,000	153,700	6,268,900	202,200	6,024,500	194,300	5,837,300	188,300
August	4,832,400	157,500	6,242,800	201,400	5,567,700	179,600	6,034,500	194,700
September	4,681,700	157,400	5,928,500	197,600	5,334,700	177,800	5,876,600	195,900
October	4,260,600	138,900	6,198,600	200,000	4,172,200	134,600	6,119,100	197,400
November	3,391,100	113,900	5,988,500	199,600	5,195,600	173,200	5,326,400	177,500
December	2,959,000	96,300	6,044,600	195,000	5,601,300	180,700	5,192,700	167,500
	52,375,500	145,000	74,037,800	202,300	67,308,200	184,400	58,497,800	160,300

[1] Before 1941 daily average production of beehive coke was calculated by subtracting Sundays and holidays in each month; 1942–45 daily average has been calculated by dividing total monthly production by total number of days in month.

TABLE 8.—Beehive coke produced in the United States in 1946, by weeks

[Estimated from railroad shipments]

Week ended—	Net tons	Week ended—	Net tons	Week ended—	Net tons
Jan. 5	[1] 67,300	May 18	26,000	Sept. 28	125,800
Jan. 12	100,600	May 25	11,200	Oct. 5	107,500
Jan. 19	97,000	June 1	9,400	Oct. 12	127,900
Jan. 26	79,300	June 8	49,600	Oct. 19	125,700
Feb. 2	89,800	June 15	96,900	Oct. 26	123,600
Feb. 9	100,100	June 22	104,400	Nov. 2	126,800
Feb. 16	87,500	June 29	110,600	Nov. 9	128,700
Feb. 23	79,500	July 6	75,900	Nov. 16	120,500
Mar. 2	104,800	July 13	101,500	Nov. 23	85,700
Mar. 9	108,600	July 20	120,700	Nov. 30	10,000
Mar. 16	112,400	July 27	123,800	Dec. 7	9,900
Mar. 23	111,900	Aug. 3	115,200	Dec. 14	83,700
Mar. 30	109,600	Aug. 10	118,600	Dec. 21	130,100
Apr. 6	18,800	Aug. 17	127,600	Dec. 28	118,800
Apr. 13	7,000	Aug. 24	118,100	Dec. 31	[2] 53,200
Apr. 20	4,100	Aug. 31	126,700		
Apr. 27	2,100	Sept. 7	110,800		4,568,400
May 4	2,100	Sept. 14	128,400		
May 11	7,900	Sept. 21	124,700		

[1] 5 days.

[2] 3 days.

TABLE 9.—Oven coke produced in the United States in 1946, by months and States, in net tons

[Based upon reports from all producers]

State	January	February	March	April	May	June	July
Alabama	356,900	220,600	448,200	286,100	210,900	411,900	468,900
California	17,100	16,300	17,900	12,500	14,200	21,100	24,000
Colorado	33,500	3,300	47,800	34,200	35,600	54,600	58,900
Illinois	230,300	174,200	245,100	219,700	188,200	247,500	317,100
Indiana	421,200	230,100	627,500	421,400	272,900	567,000	684,700
Maryland	106,400	69,400	158,500	153,600	66,400	164,300	170,000
Massachusetts	101,500	91,800	100,500	68,100	52,400	82,600	89,800
Michigan	233,300	194,600	232,600	185,500	134,400	174,500	231,700
Minnesota	72,400	57,200	74,500	69,000	64,000	69,300	72,500
New Jersey	111,900	97,400	114,500	90,300	56,300	99,600	118,700
New York	391,700	338,300	450,400	396,500	289,500	403,100	468,200
Ohio	565,600	329,000	797,400	708,000	485,200	693,300	844,200
Pennsylvania	770,700	455,300	1,277,900	863,600	465,700	1,085,000	1,351,600
Tennessee	20,800	18,800	20,200	18,100	13,000	20,000	20,000
Utah	31,600	26,700	33,200	19,000	26,100	27,900	55,200
West Virginia	166,200	145,600	190,300	161,000	86,200	154,100	198,400
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	191,200	178,600	193,200	163,200	127,900	168,600	180,600
	3,822,300	2,647,200	5,029,700	3,874,800	2,588,900	4,444,400	5,354,500
At merchant plants	1,138,300	1,036,600	1,144,000	944,200	668,900	942,300	1,104,400
At furnace plants	2,684,000	1,610,600	3,885,700	2,930,600	1,920,000	3,502,100	4,250,100

TABLE 9.—Oven coke produced in the United States in 1946, by months and States, in net tons—Continued

[Based upon reports from all producers]

State	August	September	October	November	December	Total
Alabama	469,600	474,400	488,800	442,900	386,700	4,665,900
California	29,200	27,200	26,600	31,300	23,100	260,500
Colorado	57,700	60,000	68,300	53,500	51,100	558,500
Illinois	324,200	314,700	327,100	300,900	303,400	3,192,400
Indiana	719,100	707,000	729,100	671,200	600,400	6,651,600
Maryland	170,500	161,000	167,100	134,400	140,000	1,661,600
Massachusetts	91,200	97,600	94,400	75,200	101,200	1,046,300
Michigan	232,800	227,300	236,200	217,100	199,700	2,499,700
Minnesota	76,600	75,500	77,600	73,700	78,400	860,700
New Jersey	120,800	117,300	110,800	106,800	114,400	1,258,800
New York	484,200	464,100	475,600	439,200	441,900	5,042,700
Ohio	857,400	849,800	873,300	737,700	710,700	8,451,600
Pennsylvania	1,384,200	1,347,100	1,401,600	1,209,900	1,182,100	12,794,700
Tennessee	19,800	19,500	19,400	19,500	20,600	229,700
Utah	58,500	55,300	53,900	49,700	50,000	487,100
West Virginia	220,600	206,600	215,100	213,600	204,800	2,162,500
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	178,200	172,100	180,300	177,700	188,500	2,105,100
	5,494,600	5,376,500	5,545,200	4,954,300	4,797,000	53,929,400
At merchant plants	1,105,700	1,077,800	1,093,200	1,043,500	1,089,600	12,388,500
At furnace plants	4,388,900	4,298,700	4,452,000	3,910,800	3,707,400	41,540,900

TABLE 10.—Beehive coke produced in the United States in 1946, by months and States, in net tons

[Based upon reports from producers]

State	January	February	March	April	May	June	July
Colorado	6,900	5,900	5,000	300	1,600	3,500	6,400
Kentucky	7,700	6,700	9,100	2,300	4,400	8,100	8,100
Pennsylvania	365,500	330,700	423,200	17,100	9,400	329,100	430,200
Utah	500	300	300		100	300	500
Virginia	16,100	14,400	18,400	700	5,700	16,900	17,000
West Virginia	21,800	21,400	22,200	1,700	6,600	20,000	20,600
	418,500	379,400	478,200	22,100	27,800	377,900	482,800

State	August	September	October	November	December	Total
Colorado	6,800	6,400	7,100	3,500	5,400	58,800
Kentucky	9,500	8,000	8,800	5,900	6,800	85,400
Pennsylvania	481,200	446,100	515,100	331,000	348,600	4,027,200
Utah	500	500	400	300	1,500	5,200
Virginia	19,400	17,300	18,900	12,400	14,000	171,200
West Virginia	22,500	21,800	23,600	19,000	19,400	220,600
	539,900	500,100	573,900	372,100	395,700	4,568,400

PRODUCTION BY FURNACE AND MERCHANT PLANTS

The terms "furnace" and "merchant" plants, as used in this report, apply to oven-coke plants only. When compared with the 1945 output, production at both groups of plants shows marked reductions. Production of coke at furnace plants in 1946 was affected not only by work stoppages in the bituminous-coal industry but also by the steel strike in January and February; as a consequence, output dropped 15 percent below that in 1945. Although production at merchant plants was not directly affected by the steel strike, curtailed operations at these plants during the two coal strikes reduced the output of this

group 8 percent from 1945. Because of the higher level of activity of the merchant plants during the steel strike, the proportion of the total oven-coke production from this group increased from 21.6 percent in 1945 to 23.0 percent in 1946. The number of active furnace plants remained the same as in 1945 because loss of the Sheffield Steel plant at Houston, Tex., was offset by the change in classification of the Morgantown, W. Va., plant from "merchant" to "furnace" following its lease from the War Department by the Sharon Steel Corp. in July. The decrease in number of merchant plants from 1945 was due (in addition to the above change) to the removal of the plant at Battle Creek, Mich., which suspended operation in July 1945. Tables 11 and 12 summarize statistics on production of both groups of plants.

TABLE 11.—Number and production of oven-coke plants connected with iron furnaces and of other plants in the United States, 1913, 1918, 1937, and 1944–46

Year	Number of active plants		Coke produced (net tons)		Percent of production	
	Furnace plants	Merchant plants	Furnace plants	Merchant plants	Furnace plants	Merchant plants
1913	20	16	9,277,832	3,436,868	73.0	27.0
1918	36	24	19,220,342	6,777,238	73.9	26.1
1937	43	42	36,134,209	13,076,539	73.4	26.6
1944	53	35	52,919,844	14,144,951	78.9	21.1
1945	53	34	48,695,172	13,399,116	78.4	21.6
1946	53	32	41,540,962	12,388,485	77.0	23.0

TABLE 12.—Monthly and average daily production of oven coke by plants connected with iron furnaces and by other plants in the United States, 1937 and 1945–46, in net tons

Month	1937		1945		1946	
	Furnace plants	Merchant plants	Furnace plants	Merchant plants	Furnace plants	Merchant plants
Monthly production:						
January	3,241,600	1,119,100	4,434,500	1,186,600	2,684,000	1,138,300
February	2,996,500	996,400	4,016,300	1,084,700	1,610,600	1,036,600
March	3,355,000	1,140,500	4,499,500	1,191,600	3,885,700	1,144,000
April	3,310,300	1,040,600	4,119,100	1,150,100	2,930,600	944,200
May	3,375,600	1,104,100	4,398,500	1,174,400	1,920,000	668,900
June	2,917,500	1,107,300	4,079,400	1,128,100	3,502,100	942,300
July	3,316,100	1,107,800	4,311,600	1,162,100	4,250,100	1,104,400
August	3,469,300	1,104,100	3,973,100	1,138,200	4,388,900	1,105,700
September	3,334,700	1,093,100	3,936,600	1,100,300	4,298,700	1,077,800
October	2,910,500	1,124,600	3,049,400	924,700	4,452,000	1,093,200
November	2,142,700	1,079,600	3,793,200	1,034,700	3,910,800	1,043,500
December	1,764,400	1,059,400	4,084,000	1,123,600	3,707,400	1,089,600
Total	36,134,200	13,076,600	48,695,200	13,399,100	41,540,900	12,388,500
Average daily production:						
January	104,600	36,100	143,000	38,300	86,600	36,700
February	107,000	35,600	143,400	38,800	57,500	37,000
March	108,200	36,800	145,200	38,400	125,300	36,900
April	110,300	34,700	137,300	38,300	97,700	31,500
May	108,900	35,600	141,900	37,900	61,900	21,600
June	97,300	36,900	136,000	37,600	116,700	31,400
July	107,000	35,700	139,100	37,500	137,100	35,600
August	111,900	35,600	128,200	36,700	141,600	35,700
September	111,200	36,400	131,200	36,700	143,300	35,900
October	93,900	36,300	98,400	29,800	143,600	35,300
November	71,400	36,000	126,400	34,500	130,300	34,800
December	56,900	34,200	131,700	36,300	119,600	35,100
Average	99,000	35,800	133,400	36,700	113,800	34,000

PRODUCTION BY STATES AND DISTRICTS

With the exception of California and Minnesota, production of oven coke in all producing States in 1946 declined from 1945. Texas dropped from the list of producing States, as no coke was made at either of the two oven-coke plants in that State. States reporting the largest decreases in tonnage were: Pennsylvania, 2,460,416 tons from 1945; Indiana, 1,162,680 tons; Ohio, 954,130 tons; and New York, 747,300 tons. The decline in these four States accounted for 65 percent of the total decrease in oven-coke output in 1946. Pennsylvania maintained its position as the leading coke-producing State, supplying nearly one-fourth of the total oven-coke output. Following Pennsylvania, in order of production, were Ohio, Indiana, New York, and Alabama, which combined produced 46 percent of the total.

Production of beehive coke increased in two States and decreased in four when compared with 1945. Although production of beehive coke in Pennsylvania decreased 12 percent from 1945, it remained the leading producer and supplied 88 percent of the total beehive output. Production in West Virgina and Virginia—the second and third largest beehive-coke producing States—also dropped sharply, with decreases of 23 and 10 percent, respectively. For the third consecutive year, production increased in Kentucky, and Utah's output gained slightly over 1945.

TABLE 13.—Coke produced in the United States, 1937 and 1943–46, by States, in net tons

[Exclusive of screenings or breeze]

State	1937	1943	1944	1945	1946
Oven coke:					
Alabama	4,259,771	5,316,455	5,727,612	5,400,925	4,665,939
California		317,847	339,570	256,092	260,470
Colorado	486,945	672,502	650,511	639,099	558,545
Illinois	2,998,663	3,625,457	3,878,764	3,681,516	3,192,395
Indiana	5,467,061	8,111,916	8,821,021	7,814,247	6,651,567
Maryland	1,513,651	2,059,839	2,058,233	2,024,609	1,661,608
Massachusetts	1,130,620	1,174,152	1,177,850	1,149,448	1,046,267
Michigan	2,283,518	2,948,389	3,005,424	2,805,970	2,499,664
Minnesota	704,631	956,396	894,095	825,620	860,754
New Jersey	1,015,073	1,014,268	1,022,917	1,284,020	1,258,854
New York	4,946,964	5,347,369	6,102,560	5,789,974	5,042,674
Ohio	6,737,881	10,270,758	10,338,913	9,405,710	8,451,580
Pennsylvania	13,701,262	16,518,872	16,976,574	15,255,137	12,794,721
Tennessee	89,451	254,211	219,503	236,979	229,751
Texas			184,506	140,254	
Utah	149,659	240,736	739,432	731,306	487,133
Washington	14,656	14,853			
West Virginia	1,817,993	2,611,825	2,637,591	2,462,477	2,162,453
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	1,892,949	2,286,831	2,289,719	2,190,905	2,105,074
	49,210,748	63,742,676	67,064,795	62,094,288	53,929,447
Beehive coke:					
Alabama		34,674			
Colorado	64,222	85,141	81,684	72,678	58,761
Kentucky		29,298	68,076	74,404	85,400
Pennsylvania	2,559,048	6,934,445	6,170,897	4,583,720	4,027,167
Tennessee	14,982	48,861	8,850		
Utah	6,657	84,093	21,442	4,205	5,234
Virginia	240,425	293,324	243,116	191,032	171,242
West Virginia	279,387	423,551	378,957	287,854	220,597
	3,164,721	7,933,387	6,973,022	5,213,893	4,568,401
Grand total	52,375,469	71,676,063	74,037,817	67,308,181	58,497,848

TABLE 14.—Oven coke produced in the United States in 1946, by steel-producing districts

District	Plants	Ovens	Coal charged (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens	
						Total	Per ton
Eastern	22	3,448	19,580,587	71.21	13,943,923	$129,748,346	$9.31
Pittsburgh-Youngstown	21	4,152	23,354,959	69.02	16,118,993	105,330,918	6.53
Cleveland-Detroit	10	1,475	8,474,730	71.80	6,084,952	56,896,104	9.35
Chicago	20	3,174	16,044,228	72.17	11,579,741	110,034,309	9.50
Southern	8	1,659	6,844,676	71.53	4,895,690	34,735,347	7.10
Western	4	586	2,060,306	63.40	1,306,148	13,315,188	10.19
	85	14,494	76,359,486	70.63	53,929,447	450,060,212	8.35

TABLE 15.—Coke produced in Pennsylvania in 1946, by districts

District	Plants	Ovens	Coal charged (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens	
						Total	Per ton
Oven coke:							
Eastern Pennsylvania [1]	5	796	3,930,703	71.09	2,794,145	$26,889,728	$9.62
Western Pennsylvania [2]	8	2,768	14,666,659	68.19	10,000,576	63,300,217	6.33
	13	3,564	18,597,362	68.80	12,794,721	90,189,945	7.05
Beehive coke:							
Fayette County	32	7,967	4,741,691	64.07	3,038,223	22,963,168	7.56
Westmoreland County	12	1,833	1,076,707	65.18	701,767	6,004,253	8.56
Other counties [3]	3	747	466,779	61.52	287,177	2,659,714	9.26
	47	10,547	6,285,177	64.07	4,027,167	31,627,135	7.85
Grand total	60	14,111	24,882,539	67.61	16,821,888	121,817,080	7.24

[1] Includes plants at Bethlehem, Chester, Philadelphia, Steelton, and Swedeland.
[2] Includes plants at Aliquippa, Clairton, Erie, Johnstown, Midland, Monessen, Neville Island, and Pittsburgh.
[3] Beaver, Greene, and Indiana Counties.

NUMBER AND TYPE OF OVENS

Vertical Slot-Type Coke Ovens.—The only new coke ovens completed in 1946 were 1 battery consisting of 47 ovens built by the Citizens Gas and Coke Utility at Indianapolis, Ind., and 1 battery of 37 by the Public Service Electric and Gas Co., Camden, N. J. In addition, the Carnegie-Illinois Steel Corp. completely rebuilt and placed in operation 1 battery of 87 ovens at its Clairton, Pa., works. Failure of 18 ovens at various plants, the dismantling of 1 battery of 61 ovens at Aliquippa, Pa., by the Jones & Laughlin Steel Corp., and the abandonment of 21 ovens by the Central Illinois Electric & Gas Co. at Rockford, Ill., because of the substitution of natural gas in that area brought the total number of ovens abandoned to 100 in 1946. This caused a net loss of 16 ovens from 1945, and the annual coke capacity dropped from 71,399,100 tons to 71,112,600 in 1946. Of the 14,494 ovens reported in existence at the end of the year, 36 percent were Koppers, 40 percent Koppers-Becker, 13 percent Semet-Solvay, 10 percent Wilputte, and 1 percent of miscellaneous types. Information received by the Bureau of Mines from coke producers

indicated that 824 new ovens with an annual coke capacity of 4,453,800 tons were under construction on December 31, 1946. Virtually all additional capacity under construction is for steel plants, where existing facilities cannot meet current coke requirements.

Beehive Ovens.—The extremely heavy demand for industrial coke in 1946 directed attention to beehive ovens as a source of supply. Although the number of beehive ovens in blast during the year fluctuated widely, for reasons explained in the General Summary of this report, the number of ovens in blast increased each month after the settlement of the coal strike in May, reaching a peak of 10,181 in December. Total ovens in existence, as reported by operators on December 31, 1946, totaled 12,864, with an annual coke capacity of 8,427,000 tons, compared with 12,179 ovens and 8,094,850 tons capacity in 1945.

TABLE 16.—Ovens completed and abandoned in the United States in 1946 and total number in existence at end of year, by States

State	Plants in existence Dec. 31	Ovens						
		In existence Dec. 31		New		Abandoned during year	Under construction Dec. 31	
		Number	Annual capacity (net ton of coke)	Number	Annual capacity (net tons of coke)		Number	Annual capacity (net ton of coke)
Oven coke:								
Alabama	8	[1] 1,490	6,547,300				63	443,500
California	1	90	340,000					
Colorado	1	188	813,000				[2] 74	327,000
Connecticut	1	70	[3]					
Illinois	8	[4] 856	3,899,500			26		
Indiana	5	1,863	9,341,800	47	144,000			
Kentucky	1	120	[3]					
Maryland	1	422	2,124,000				61	396,000
Massachusetts	2	215	1,289,800					
Michigan	4	568	2,926,200					
Minnesota	3	196	985,600					
Missouri	1	64	[3]					
New Jersey	2	304	1,427,000	37	137,500	13		
New York	8	1,142	6,219,800					
Ohio	15	2,099	10,228,800				210	970,700
Pennsylvania	13	3,564	17,797,200			61	204	1,112,200
Rhode Island	1	65	[3]					
Tennessee	1	44	242,000					
Texas	2	[5] 125	706,000					
Utah	2	308	1,202,800					
West Virginia	5	506	2,696,500				212	1,204,400
Wisconsin	2	195	[3]					
Undistributed			2,325,300					
	87	14,494	71,112,600	84	281,500	100	824	4,453,800
At merchant plants	32	3,205	14,459,500	84	281,500	39	8	45,700
At furnace plants	55	11,289	56,653,100			61	816	4,408,100
Beehive coke:								
Colorado	1	160	85,000					
Kentucky	1	195	172,000	4	3,500			
Pennsylvania	53	10,547	7,172,900	589	400,500	11		
Utah	1	297	147,000					
Virginia	5	750	376,200	1	500			
West Virginia	7	915	473,900	102	57,000			
	68	12,864	8,427,000	[6] 696	461,500	11		

[1] 240 ovens idle entire year.
[2] Completed but idle.
[3] Included under "Undistributed."
[4] 1 plant abandoned in August.
[5] Idle entire year.
[6] Old ovens rehabilitated.

TABLE 17.—Vertical slot-type ovens, by kinds, in the United States at end of 1946, by States

State	Koppers	Koppers-Becker	Semet-Solvay	Wilputte	All others [1]	Total
Alabama	459	486	420	125		1,490
California		90				90
Colorado	116	72				188
Connecticut		70				70
Illinois	375	198	120	163		856
Indiana	406	812	161	484		1,863
Kentucky			120			120
Maryland	300	122				422
Massachusetts		160		55		215
Michigan		222	346			568
Minnesota	155	41				196
Missouri	56				8	64
New Jersey	165	139				304
New York	150	608	180	152	52	1,142
Ohio	1,238	431	293	137		2,099
Pennsylvania	1,550	1,674	88	132	120	3,564
Rhode Island	40	25				65
Tennessee			24	20		44
Texas		125				125
Utah		308				308
West Virginia	154	207		145		506
Wisconsin	100	15	80			195
	5,264	5,805	1,832	1,413	180	14,494
At merchant plants	741	1,113	962	329	60	3,205
At furnace plants	4,523	4,692	870	1,084	120	11,289

[1] Comprises 52 American Foundation, 120 Cambria, and 8 Piette.

TABLE 18.—Average number of beehive ovens active in the United States in 1946, by months

Month	Number	Month	Number	Month	Number
January	8,622	May	1,891	September	9,766
February	8,598	June	8,894	October	9,885
March	8,788	July	9,566	November	9,990
April	1,226	August	9,741	December	10,181

CAPACITY OF OVEN-COKE PLANTS

The basis upon which potential maximum capacity of a coke plant is established is the minimum coking time at which the ovens can be operated to produce coke with qualities suitable for the use for which it is intended. The operators are requested to report the potential maximum annual coke capacity of their ovens "of grades you aim to produce, that can be obtained with all conditions favorable and all ovens active." Potential maximum annual coke capacity, as thus stated, is subject to change from year to year, depending on the age and condition of ovens, character and quality of coal charged, and economic and labor conditions.

The annual coke capacity of all oven-coke plants in existence, both idle and active, decreased for the second consecutive year in 1946, and on December 31 was 286,500 tons below the 1945 figure. The annual capacity of furnace plants decreased 0.1 percent in spite of the change in classification of one plant from furnace to merchant, and the capacity of merchant plants declined 2 percent. The operating ratio in 1946 fluctuated widely between a low of 41.7 percent in

May to a high of 89.4 percent in September. The average rate of production for the year was 73.8 percent of capacity—10.5 points below the rate of production of 1945. Tables 19 and 20 show the potential maximum annual capacity of all ovens in existence (whether idle or active) and the relationship between capacity and production for 1937 and 1943–46.

TABLE 19.—Potential maximum annual coke capacity of all oven-coke plants in existence in the United States, 1937 and 1943–46

Year	Plants	Ovens	Potential maximum annual coke capacity (net tons)	Percent of change from 1937
1937	87	12,718	62,727,075	
1943	92	14,253	71,378,408	+13.8
1944	89	14,580	72,330,200	+15.3
1945	88	14,510	71,399,100	+13.8
1946	87	14,494	71,112,600	+13.4

TABLE 20.—Relationship of production to potential maximum capacity [1] at oven-coke plants in the United States, 1937 and 1943–46, by months, in percent

Month	1937	1943	1944	1945	1946	Month	1937	1943	1944	1945	1946
January	83.0	98.7	95.8	89.1	61.8	August	86.0	96.3	91.1	82.4	88.4
February	83.5	98.8	96.6	89.6	47.4	September	86.1	96.7	89.8	84.0	89.4
March	84.9	98.0	95.7	90.2	81.3	October	76.0	94.7	91.1	64.1	89.2
April	84.9	98.0	96.2	86.3	64.6	November	62.8	90.7	90.8	80.5	82.4
May	84.6	96.4	95.5	88.4	41.7	December	53.1	94.2	89.7	83.2	77.2
June	78.6	92.6	94.3	85.3	73.9						
July	83.2	93.3	91.5	88.3	86.2	Year	78.8	95.7	93.1	84.3	73.8

[1] Capacity of all ovens in existence, whether active or idle, based upon maximum daily capacity times days in month.

QUANTITY AND COST OF COAL CHARGED

General conditions in the coke industry in 1946, referred to in earlier sections of this report, resulted in a decrease of 12,144,500 tons, or 13 percent, from 1945 in quantity of coal carbonized; consequently, consumption of coal in coke ovens totaled only 83,526,900 tons. The quantity of coal charged into vertical slot-type ovens accounted for 91 percent of the total consumption but was 13 percent below that used in 1945. Beehive ovens consumed over 7,000,000 tons of coal in 1946, a decrease of 12 percent from 1945 and of 44 percent from the World War II peak in 1942.

As in previous years, Pennsylvania led all States in coking-coal consumption, accounting for 30 percent of the Nation's total. Following Pennsylvania in order were Ohio, with 14 percent of the total; Indiana, 11 percent; New York, 9 percent; and Alabama, 8 percent.

Costs of coal for both slot-type and beehive-coke ovens soared to new peaks in 1946. The average cost of $5.77 per ton for coal delivered to oven-coke plants was $0.37 above the previous maximum established in 1920 and 9 percent higher than in 1945. An increase of $0.08 per ton over the 1945 peak was recorded in the coal costs for beehive ovens. The increased costs for coal were due largely to increases in mining costs resulting from the wage agreement con-

cluded between the miners and the Government in May 1946. Increases in freight rates granted to the railroads by the Interstate Commerce Commission in July were also a factor in raising the costs of coal delivered to oven-coke plants.

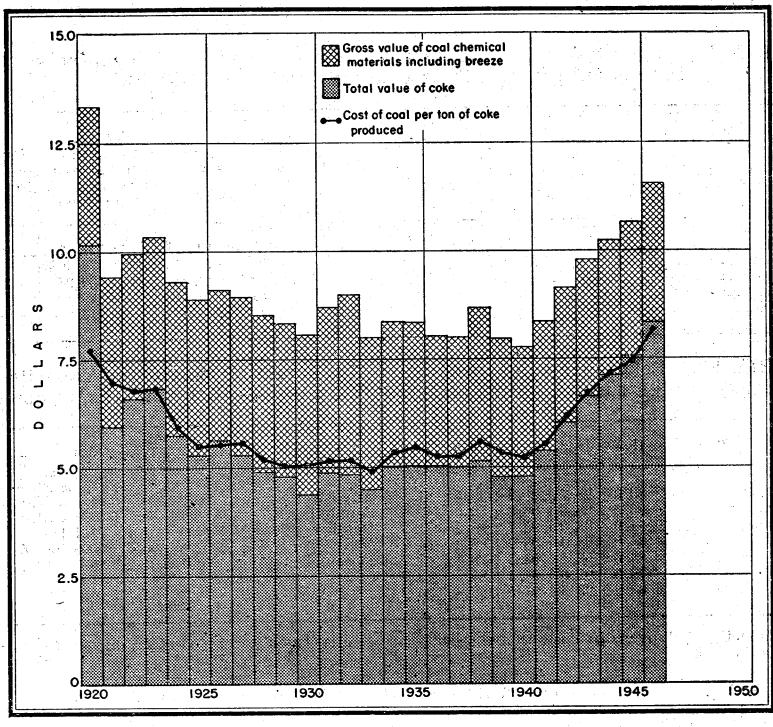

FIGURE 2.—Cost of coal and value of all products per net ton of coke produced in the United States, 1920–46.

TABLE 21.—Coal consumed in coke ovens in the United States, 1937 and 1945–46, by months, in net tons

Month	1937			1945			1946		
	Vertical slot type	Beehive	Total	Vertical slot type	Beehive	Total	Vertical slot type	Beehive	Total
January	6, 198, 700	426, 600	6, 625, 300	7, 913, 800	717, 600	8, 631, 400	5, 415, 600	656, 400	6, 072, 000
February	5, 679, 900	458, 500	6, 138, 400	7, 196, 200	711, 600	7, 907, 800	3, 765, 900	595, 000	4, 360, 900
March	6, 387, 000	556, 800	6, 943, 800	8, 045, 700	832, 300	8, 878, 000	7, 116, 500	749, 700	7, 866, 200
April	6, 183, 800	480, 800	6, 664, 600	7, 447, 800	591, 000	8, 038, 800	5, 519, 300	34, 500	5, 553, 800
May	6, 368, 500	509, 700	6, 878, 200	7, 858, 800	871, 300	8, 730, 100	3, 670, 900	44, 600	3, 715, 500
June	5, 729, 200	430, 500	6, 159, 700	7, 335, 200	873, 500	8, 208, 700	6, 330, 200	593, 600	6, 923, 800
July	6, 217, 200	441, 700	6, 658, 900	7, 687, 400	856, 700	8, 544, 100	7, 565, 100	757, 300	8, 322, 400
August	6, 425, 800	401, 100	6, 826, 900	7, 176, 900	711, 200	7, 888, 100	7, 795, 600	847, 000	8, 642, 600
September	6, 220, 700	392, 800	6, 613, 500	7, 123, 600	466, 800	7, 590, 400	7, 587, 400	784, 400	8, 371, 800
October	5, 664, 800	351, 600	6, 016, 400	5, 616, 500	313, 700	5, 930, 200	7, 828, 500	899, 900	8, 728, 400
November	4, 527, 000	264, 000	4, 791, 000	6, 795, 400	574, 400	7, 369, 800	7, 001, 100	583, 700	7, 584, 800
December	3, 972, 800	212, 700	4, 185, 500	7, 339, 500	614, 500	7, 954, 000	6, 763, 400	621, 300	7, 384, 700
	69, 575, 400	4, 926, 800	74, 502, 200	87, 536, 800	8, 134, 600	95, 671, 400	76, 359, 500	7, 167, 400	83, 526, 900

TABLE 22.—Quantity and value at ovens of coal used in manufacturing coke in the United States in 1946, by States

State	Coal used (net tons)	Cost of coal		Coal per ton of coke	
		Total	Average	Net tons	Cost
Oven coke:					
Alabama	6,530,336	$32,375,532	$4.96	1.40	$6.94
California	420,297	(1)	(1)	1.61	(1)
Colorado	832,415	(1)	(1)	1.49	(1)
Illinois	4,505,323	30,196,121	6.70	1.41	9.46
Indiana	9,198,959	62,090,861	6.75	1.38	9.33
Maryland	2,296,212	(1)	(1)	1.38	(1)
Massachusetts	1,497,347	(1)	(1)	1.43	(1)
Michigan	3,471,559	20,730,941	5.97	1.39	8.29
Minnesota	1,192,679	8,183,014	6.86	1.39	9.51
New Jersey	1,738,942	(1)	(1)	1.38	(1)
New York	7,108,999	47,711,634	6.71	1.41	9.46
Ohio	11,924,954	68,236,447	5.72	1.41	8.07
Pennsylvania	18,597,362	89,163,514	4.79	1.45	6.97
Tennessee	314,340	(1)	(1)	1.37	(1)
Utah	807,594	(1)	(1)	1.66	(1)
West Virginia	3,072,457	11,797,384	3.84	1.42	5.46
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	2,849,711	18,337,072	6.43	1.35	8.71
Undistributed		51,720,980	6.54	1.44	9.40
	76,359,486	440,543,500	5.77	1.42	8.17
At merchant plants	17,197,125	111,390,675	6.48	1.39	8.99
At furnace plants	59,162,361	329,152,825	5.56	1.42	7.92
Beehive coke:					
Colorado	90,831	(1)	(1)	1.55	(1)
Kentucky	133,522	(1)	(1)	1.56	(1)
Pennsylvania	6,285,177	22,431,414	3.57	1.56	5.57
Utah	11,553	(1)	(1)	2.21	(1)
Virginia	291,852	1,022,973	3.51	1.70	5.97
West Virginia	354,489	1,282,379	3.62	1.61	5.81
Undistributed		985,914	4.18	1.58	6.60
	7,167,424	25,722,680	3.59	1.57	5.63

[1] Included under "Undistributed."

TABLE 23.—Average cost per net ton of coal carbonized at oven-coke plants in the United States, 1937 and 1943–46, by States

State	1937	1943	1944	1945	1946
Alabama	$2.33	$3.60	$4.03	$4.47	$4.96
Illinois	4.62	5.62	6.04	6.16	6.70
Indiana	4.71	5.85	6.11	6.23	6.75
Michigan	4.16	4.57	5.39	5.55	5.97
Minnesota	5.24	6.02	6.35	6.52	6.86
New York	4.55	5.59	5.88	6.04	6.71
Ohio	3.76	4.73	5.03	5.27	5.72
Pennsylvania	2.98	3.96	4.28	4.40	4.79
West Virginia	2.54	3.19	3.32	3.56	3.84
Other States [1]	4.53	5.59	5.72	5.94	6.51
United States average	3.74	4.75	5.08	5.28	5.77
Cost of coal per ton of coke	5.27	6.70	7.16	7.45	8.17

[1] California, Colorado, Connecticut, Kentucky, Maryland, Massachusetts, Missouri, New Jersey, Rhode Island, Tennessee, Texas, Utah, and Wisconsin.

TABLE 24.—Cost of coal and value of products per net ton of coke produced in the United States, 1918, 1929, and 1937–46

Year	Oven coke				Beehive coke	
	Cost of coal per ton of coke	Value per ton of coke produced			Cost of coal per ton of coke	Value per ton
		Coke	Coal chemical materials [1]	Total		
1918	$6.00	$7.42	$3.08	$10.50	$3.65	$6.21
1929	5.04	4.80	3.56	8.36	2.85	3.49
1937	5.27	5.03	2.97	8.00	3.14	4.31
1938	5.61	5.16	3.53	8.69	3.32	4.42
1939	5.36	4.82	3.19	8.01	3.16	4.45
1940	5.23	4.82	2.99	7.81	3.12	4.41
1941	5.53	5.41	2.98	8.39	3.66	5.44
1942	6.18	6.07	3.10	9.17	3.93	5.75
1943	6.70	6.65	3.13	9.78	4.77	6.55
1944	7.16	7.14	3.10	10.24	5.15	7.04
1945	7.45	7.57	3.07	10.64	5.48	7.36
1946	8.17	8.35	3.20	11.55	5.63	8.63

[1] Includes value of breeze produced.

PREPARATION AND SOURCE OF COAL

Washed and Unwashed Coal.—In recent years more emphasis has been placed on the mechanical cleaning of coal used for the manufacture of coke. Mechanical loading of coal, although affording reductions in mining costs, often results in a large increase in the refuse content of the run-of-mine coal so that mechanical cleaning in many areas is essential for the production of satisfactory coke. One of the greatest advantages of clean coal, especially when used for the manufacture of metallurgical coke, is its greater uniformity in qualities, which are reflected in higher uniformity in the physical and chemical qualities of the coke. In 1946, 27 percent of the total tonnage of coal carbonized was washed before being charged into ovens. Both pneumatic cleaning and wet washing methods are employed to prepare the coal for use in coke ovens, in accordance with local conditions throughout the areas concerned with the problem. All coal mined in Colorado and used for the manufacture of coke was washed in 1946; most of Tennessee's and Alabama's and about one-third of Pennsylvania's was also washed before being charged into ovens. Data in table 25 include coal cleaned at the mines by coal producers as well as that cleaned at the coke plant by coke operators. Coal cleaned at the mines was used by 37 oven- and 6 beehive-coke plants in 1946; in addition, 7 oven plants charged coal that was cleaned in cleaning plants at the ovens.

Sources.—Since the establishment of the coke industry in the United States, the great source of coking coal has been the Appalachian region, extending from Alabama to Pennsylvania. States in this region supplied more than 96 percent of all coal purchased in 1946 for the manufacture of oven coke. In order of tonnages, the ranking States which shipped coal to oven-coke plants were West Virginia and Pennsylvania, each furnishing 36 percent of the total; Kentucky, 14 percent; Alabama, 8 percent; and Virginia and Tennessee combined, 2 percent. Other States that supplied significant tonnages of coking coal were Utah and Colorado, which together furnished 2 percent of the total. The best high-, medium-, and low-volatile coking coals are found in West Virginia, Eastern Kentucky, Western Virginia, Pennsylvania, and Alabama. The low-volatile coking coals, which are very important for improving the physical properties of metallurgical coke—especially its strength—come mostly from West Virginia and to some extent from Central Pennsylvania, Western Virignia, Oklahoma, and Arkansas. The expansion of the steel industry in the far West during the recent war has focused attention on the supply of coking coal for coke plants in that area. The present source of coking coal for the steel plants in Utah and California is the Sunnyside bed of Utah. The Bureau of Mines, through exploration, has discovered additional reserves of coking coal near Kemmerer,[2] southwestern Wyo., and in Gunnison County, Colo.[3]

Coke-plant operators reported that 59 percent of all coal purchased for the manufacture of oven coke was obtained from captive mines in 1946.

Blending.—In 1946, 72 of the 85 active plants carbonized coals of different volatile content. High- and low-volatile coals were carbonized by 46 plants; high-, medium-, and low-volatile by 20 plants; medium- and low-volatile by 3 plants; and high- and medium-volatile by 3 plants. Of the plants that did not carbonize coals of different volatile content, 10 used straight high-volatile and 3 medium-volatile. At plants where blending is practiced, the proportion of the different kinds of coals mixed before charging into ovens varies widely from plant to plant according to local conditions. A classification of all coal purchased for coking in slot-type ovens in 1946 indicated, however, that 66 percent was high-volatile, 13 percent medium-volatile, and 21 percent low-volatile.

[2] Toenges, Albert L., Davis, J. D., Turnbull, Louis A., and Schopf, J. M., Reserves, Bed Characteristics, and Coking Properties of the Willow Creek Coal Bed, Kemmerer District, Lincoln County, Wyo.: Bureau of Mines Tech. Paper 673, 1945, 48 pp.

[3] Toenges, Albert L., Turnbull, Louis A., Davis, J. D., and Reynolds, D. A., Investigation of Coal Deposits in the Coal Creek District, Gunnison County, Colo.: Bureau of Mines Rept. of Investigations 4104, 1947, 20 pp.

TABLE 25.—Washed and unwashed coal used in manufacturing coke in the United States in 1946, by States in which used, in net tons

State	Vertical slot-type ovens				Beehive ovens		
	Bituminous		Anthracite	Total	Bituminous		
	Washed	Unwashed			Washed	Unwashed	Total
Alabama	6,348,549	181,787		6,530,336			
California	363,722	56,575		420,297			
Colorado	832,415			832,415	90,831		90,831
Illinois	1,101,418	3,379,543	24,362	4,505,323			
Indiana	134,000	9,064,959		9,198,959			
Maryland		2,296,212		2,296,212			
Massachusetts		1,497,347		1,497,347			
Michigan	175,337	3,232,060	64,162	3,471,559			
Minnesota	29,381	1,163,298		1,192,679			
New Jersey		1,738,942		1,738,942			
New York	715,821	6,337,915	55,263	7,108,999			
Ohio	3,152,855	8,771,599	500	11,924,954			
Pennsylvania	7,220,243	11,314,670	62,449	18,597,362	801,076	5,484,101	6,285,177
Tennessee	203,386	110,954		314,340			
Utah		807,594		807,594		11,553	11,553
Virginia						291,852	291,852
West Virginia	1,224,070	1,843,428	4,959	3,072,457		354,489	354,489
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin		2,822,594	27,117	2,849,711		133,522	133,522
	21,501,197	54,619,477	238,812	76,359,486	891,907	6,275,517	7,167,424
At merchant plants	1,408,494	15,732,193	56,438	17,197,125			
At furnace plants	20,092,703	38,887,284	182,374	59,162,361			

TABLE 26.—Coal purchased for manufacturing oven coke in the United States in 1946, by fields of origin

State and district where coal produced	Total purchased (net tons)	States where coal consumed—in order of importance
Alabama	6,443,879	Alabama and Tennessee.
Arkansas	95,609	Colorado, California, Illinois, Minnesota, and Utah.
Colorado	581,190	Colorado.
Illinois	420,131	Illinois, Indiana, and Minnesota.
Indiana	83,431	Illinois, Wisconsin, and Indiana.
Kentucky:		
Elkhorn	3,844,561	Indiana, Ohio, New York, Illinois, New Jersey, Michigan, Minnesota, Pennsylvania, Kentucky, Massachusetts, Wisconsin, and Connecticut.
Harlan	5,202,122	Indiana, Illinois, Ohio, Minnesota, Pennsylvania, Tennessee, Maryland, Wisconsin, and New York.
Kenova-Thacker	1,495,335	Michigan, Ohio, Wisconsin, Pennsylvania, Connecticut, and New Jersey.
Maryland	5,694	Pennsylvania and Ohio.
New Mexico	310,757	Colorado and California.
Ohio	53	Ohio.
Oklahoma	32,437	California and Colorado.
Pennsylvania:		
Anthracite	243,947	Michigan, Pennsylvania, New York, Illinois, Missouri, Wisconsin, and West Virginia.
Central Pennsylvania:		
High-volatile	977,579	New York and Pennsylvania.
Medium-volatile	365,164	New York, Maryland, and Pennsylvania.
Low-volatile	2,080,999	Pennsylvania, Ohio, New York, and Maryland.
Connellsville	11,823,161	Pennsylvania, Ohio, West Virginia, Illinois, New York, Indiana, Maryland, and Minnesota.
Freeport	2,090,267	Ohio, West Virginia, Michigan, New York, and Pennsylvania.
Pittsburgh	8,486,344	Pennsylvania, New York, Ohio, and Michigan.
Somerset	430,274	Pennsylvania, West Virginia, New York, and Ohio.
Westmoreland	1,184,418	Pennsylvania, Ohio, Wisconsin, and New York.
Tennessee	207,974	Tennessee and Minnesota.
Utah	1,180,753	Utah and California.
Virginia:		
Pocahontas	651,676	Indiana, New York, and New Jersey.
Southwestern	86,001	New York and Pennsylvania.
Williamson	755,452	Michigan, Ohio, New Jersey, Massachusetts, Indiana, Wisconsin, New York and Pennsylvania.
West Virginia:		
Coal and Coke	8,947	Connecticut.
Coal River	24,855	Michigan and Ohio.
Kanawha	6,585,954	Ohio, Illinois, Kentucky, New Jersey, Indiana, West Virginia, Massachusetts, Wisconsin, Pennsylvania, Connecticut, Missouri, Rhode Island, Minnesota, Michigan, New York, and Maryland.
Kenova-Thacker	472,158	New Jersey and Pennsylvania.
Logan	2,104,964	Ohio, Indiana, New York, Massachusetts, Michigan, Pennsylvania, Connecticut, Minnesota, and Illinois.
New River:		
High-volatile	822,305	New York, New Jersey, Illinois, Rhode Island, and Massachusetts.
Medium-volatile	409,684	Massachusetts, New York, and Pennsylvania.
Low-volatile	456,272	Maryland, Michigan, and Minnesota.
Northern	4,014,957	Pennsylvania, Maryland, West Virginia, Michigan, New York, and Ohio.
Pocahontas	10,500,597	Indiana, Ohio, Illinois, New York, Michigan, Maryland, Pennsylvania, Minnesota, Wisconsin, Missouri, Alabama, Connecticut, West Virginia, Kentucky, Tennessee, and Rhode Island.
Tug River	152,370	Kentucky and New York.
Webster-Gauley	1,081,403	Pennsylvania, New York, New Jersey, Maryland, Wisconsin, and Massachusetts.
Williamson	99,533	Massachusetts, Ohio, and Connecticut.
Winding Gulf	1,419,064	New Jersey, Massachusetts, Ohio, Illinois, Michigan, New York, and Rhode Island.
Wyoming	56	California.
	77,232,327	

TABLE 27.—Coal purchased for manufacturing oven coke in the United States in 1946, by States where produced and where consumed and by merchant and furnace plants, in net tons

State where coal consumed	Coal produced in—															
	Alabama	Arkansas	Colorado	Illinois	Indiana	Kentucky	Maryland	New Mexico	Ohio	Oklahoma	Pennsylvania	Tennessee	Utah	Virginia	West Virginia	Wyoming	Total
Alabama:																	
Merchant plants	984,030														112,310		1,096,340
Furnace plants	5,443,246														5,845		5,449,091
Total Alabama	6,427,276														118,155		6,545,431
California:																	
Furnace plant		34,566						457		21,017			361,994			56	418,090
Colorado:																	
Furnace plant		60,140	581,190					310,300		11,420							963,050
Illinois:																	
Merchant plants						39,520					29,290				682,401		751,211
Furnace plants		674		214,545	36,987	1,441,055					360,870				1,644,058		3,698,189
Total Illinois		674		214,545	36,987	1,480,575					390,160				2,326,459		4,449,400
Indiana:																	
Merchant plants														65,500	906,320		971,820
Furnace plants				176,205	14,115	3,975,770					134,000			590,241	3,521,369		8,411,700
Total Indiana				176,205	14,115	3,975,770					134,000			655,741	4,427,689		9,383,520
Maryland:																	
Furnace plant						25,796					94,604				2,220,289		2,340,689
Massachusetts:																	
Merchant plants						10,745								88,171	1,394,511		1,493,427
Michigan:																	
Merchant plants											220,483			174,858	556,569		951,910
Furnace plants						1,201,587					236,417			108,394	911,955		2,458,353
Total Michigan						1,201,587					456,900			283,252	1,468,524		3,410,263
Minnesota:																	
Merchant plant		175		29,381		78,976						9,483			290,895		408,910
Furnace plants						530,016					17,807				275,277		823,100
Total Minnesota		175		29,381		608,992					17,807	9,483			566,172		1,232,010
New Jersey:																	
Merchant plants						119,304								130,161	1,541,764		1,791,229

New York:																	
Merchant plants						380,983					1,542,351			93,294	1,784,502		3,801,130
Furnace plants						162,032					2,349,585			61,232	803,602		3,376,451
Total New York						543,015					3,891,936			154,526	2,588,104		7,177,581
Ohio:																	
Merchant plants						111,666					9,066			120,925	1,293,669		1,535,326
Furnace plants						2,065,823	316		53		4,822,982			40,000	3,476,558		10,405,732
Total Ohio						2,177,489	316		53		4,832,048			160,925	4,770,227		11,941,058
Pennsylvania:																	
Merchant plants											32,897				778,439		811,336
Furnace plants						219,187	5,378				15,706,352			1,698	2,262,285		18,194,900
Total Pennsylvania						219,187	5,378				15,739,249			1,698	3,040,724		19,006,236
Tennessee:																	
Furnace plant	16,603					89,748						198,491			27,594		332,436
Utah:																	
Furnace plants		54											818,759				818,813
West Virginia:																	
Merchant plants											5,738				781,512		787,250
Furnace plants											2,063,997				247,831		2,311,828
Total West Virginia											2,069,735				1,029,343		3,099,078
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin:																	
Merchant plants					32,329	89,810					55,714			18,655	2,633,508		2,830,016
	6,443,879	95,609	581,190	420,131	83,431	10,542,018	5,694	310,757	53	32,437	27,682,153	207,974	1,180,753	1,493,129	28,153,063	56	77,232,327
At merchant plants	984,030	175		29,381	32,329	831,004					1,895,539	9,483		691,564	12,756,400		17,229,905
At furnace plants	5,459,849	95,434	581,190	390,750	51,102	9,711,014	5,694	310,757	53	32,437	25,786,614	198,491	1,180,753	801,565	15,396,663	56	60,002,422

TABLE 28.—Coal purchased for manufacturing oven coke in the United States in 1946, by States where consumed and by volatile content [1]

State where coal consumed	High-volatile		Medium-volatile		Low-volatile		Total coal purchased (net tons)
	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total	
Alabama:							
Merchant plants	353,842	32.3	630,188	57.5	112,310	10.2	1,096,340
Furnace plants	201,510	3.7	5,241,736	96.2	5,845	.1	5,449,091
Total Alabama	555,352	8.5	5,871,924	89.7	118,155	1.8	6,545,431
California: Furnace plant	366,241	87.6			51,849	12.4	418,090
Colorado: Furnace plant	349,821	36.3	541,669	56.3	71,560	7.4	963,050
Illinois:							
Merchant plants	193,684	25.8	289,976	38.6	267,551	35.6	751,211
Furnace plants	2,601,154	70.3			1,097,035	29.7	3,698,189
Total Illinois	2,794,838	62.8	289,976	6.5	1,364,586	30.7	4,449,400
Indiana:							
Merchant plants	478,307	49.2	96,950	10.0	396,563	40.8	971,820
Furnace plants	4,719,943	56.1			3,691,757	43.9	8,411,700
Total Indiana	5,198,250	55.4	96,950	1.0	4,088,320	43.6	9,383,520
Maryland: Furnace plant	1,637,425	70.0	34,991	1.5	668,273	28.5	2,340,689
Massachusetts: Merchant plants	892,452	59.8	314,426	21.0	286,549	19.2	1,493,427
Michigan:							
Merchant plants	518,378	54.5			433,532	45.5	951,910
Furnace plants	1,934,577	78.7			523,776	21.3	2,458,353
Total Michigan	2,452,955	71.9			957,308	28.1	3,410,263
Minnesota:							
Merchant plant	263,478	64.4	40,962	10.0	104,470	25.6	408,910
Furnace plants	547,823	66.6			275,277	33.4	823,100
Total Minnesota	811,301	65.9	40,962	3.3	379,747	30.8	1,232,010
New Jersey: Merchant plants	894,159	49.9	538,039	30.0	359,031	20.1	1,791,229
New York:							
Merchant plants	2,960,583	77.9	383,740	10.1	456,807	12.0	3,801,130
Furnace plants	2,267,366	67.2	385,357	11.4	723,728	21.4	3,376,451
Total New York	5,227,949	72.8	769,097	10.7	1,180,535	16.5	7,177,581
Ohio:							
Merchant plants	919,932	59.9	140,993	9.2	474,401	30.9	1,535,326
Furnace plants	7,589,743	72.9	152,774	1.5	2,663,215	25.6	10,405,732
Total Ohio	8,509,675	71.3	293,767	2.4	3,137,616	26.3	11,941,058
Pennsylvania:							
Merchant plants	343,271	42.3	357,455	44.1	110,610	13.6	811,336
Furnace plants	15,561,421	85.5	296,675	1.6	2,336,804	12.9	18,194,900
Total Pennsylvania	15,904,692	83.7	654,130	3.4	2,447,414	12.9	19,006,236
Tennessee: Furnace plant	89,748	27.0	215,094	64.7	27,594	8.3	332,436
Utah: Furnace plants	818,759	100.0			54		818,813
West Virginia:							
Merchant plants	711,101	90.3			76,149	9.7	787,250
Furnace plants	2,175,550	94.1			136,278	5.9	2,311,828
Total West Virginia	2,886,651	93.1			212,427	6.9	3,099,078
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin:							
Merchant plants	1,949,565	68.9	157,934	5.6	722,517	25.5	2,830,016
	51,339,833	66.5	9,818,959	12.7	16,073,535	20.8	77,232,327
At merchant plants	10,478,752	60.8	2,950,663	17.1	3,800,490	22.1	17,229,905
At furnace plants	40,861,081	68.1	6,868,296	11.4	12,273,045	20.5	60,002,422

[1] Low-volatile—dry V. M. 22 percent or less and more than 14 percent; medium-volatile—dry V. M. 31 percent or less and more than 22 percent; high-volatile—dry V. M. more than 31 percent.

YIELD OF COKE PER TON OF COAL

TABLE 29.—Yield of coke from coal in the United States, 1937 and 1944–46, by States, in percent

State	1937		1944		1945		1946	
	Oven coke	Beehive coke	Oven coke	Beehive coke	Oven coke	Beehive coke	Oven coke	Beehive coke
Alabama	72.37		72.34		71.62		71.45	
California			59.29		58.27		61.97	
Colorado	67.36	55.71	64.32	65.36	65.18	64.96	67.10	64.69
Illinois	70.54		70.75		70.83		70.86	
Indiana	72.04		73.13		73.48		72.31	
Maryland	72.62		72.84		73.16		72.36	
Massachusetts	69.99		70.49		70.85		69.87	
Michigan	71.05		72.60		71.42		72.00	
Minnesota	70.27		71.58		71.33		72.17	
New Jersey	70.78		70.75		71.29		72.39	
New York	71.75		70.66		70.40		70.93	
Ohio	71.61		71.88		71.26		70.87	
Pennsylvania	68.83	65.50	70.02	64.58	70.14	64.46	68.80	64.07
Tennessee	69.00	53.89	71.73	57.35	74.34		73.09	
Texas			69.53		69.55			
Utah	56.67	54.25	53.98	50.19	57.33	52.93	60.32	45.30
Virginia		58.33		58.53		58.75		58.67
Washington	56.11							
West Virginia	70.67	61.74	69.92	62.94	70.09	62.64	70.38	62.23
United States average	70.73	64.23	71.01	64.22	70.94	64.10	70.63	63.74

COKE BREEZE

TABLE 30.—Coke breeze recovered at coke plants in the United States in 1946, by States

State	Yield per ton of coal (percent) [1]	Produced		Used by producer— For steam raising		Used by producer— For other purposes including water gas		Sold		Wasted (net tons)	On hand Dec. 31 (net tons)
		Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value		
Oven coke:											
Alabama	3.91	255,582	$1,053,877	137,292	$438,136	30,752	$131,836	103,351	$552,593		11,765
California	5.73	24,081	(2)			13,322	(2)	7,818	(2)		32,939
Colorado	7.77	64,709	(2)	12,677	(2)	48,211	(2)	8,276	(2)		2,145
Illinois	6.06	273,121	745,817	176,044	480,473	12,433	29,428	125,430	350,630		71,060
Indiana	5.08	467,415	1,151,716	343,242	888,856	106,142	259,004	178,625	334,664		48,912
Maryland	7.62	174,874	(2)	35,671	(2)	26,197	(2)	128,709	(2)		193,584
Massachusetts	8.30	124,237	(2)	110,215	(2)	5,804	(2)	10,321	(2)		9,042
Michigan	5.55	192,631	719,162	114,170	396,270	21,610	80,500	76,581	313,924		13,483
Minnesota	7.21	85,999	276,223	54,488	159,188	7,670	(2)	21,889	84,015		42,083
New Jersey	5.97	103,890	(2)	106,968	(2)			152	(2)		10,687
New York	5.70	405,339	1,227,195	326,516	962,267	69,236	218,248	27,333	85,354		50,168
Ohio	5.84	696,256	1,811,767	441,423	1,097,227	172,697	479,963	130,866	394,436		101,932
Pennsylvania	5.17	961,822	2,382,477	949,468	2,427,283	46,130	100,881	83,978	189,553	233	71,703
Tennessee	2.84	8,940	(2)	6,284	(2)			12,979	(2)		
Utah	7.44	60,100	(2)	80,642	(2)	5,782	(2)	29,930	(2)	3,253	7,816
West Virginia	5.14	157,920	313,468	94,635	190,563	30,905	(2)	38,005	74,976		30,113
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	6.15	175,336	568,103	144,442	443,242	70	(2)	39,344	155,227		14,820
Undistributed			1,467,761		971,473		281,637		513,712		
Total 1946	5.54	4,232,252	11,717,566	3,134,177	8,454,978	596,961	1,581,497	1,023,587	3,049,084	3,486	712,252
At merchant plants	5.96	1,024,459	3,323,723	787,830	2,369,231	60,809	212,235	252,756	989,765		106,591
At furnace plants	5.42	3,207,793	8,393,843	2,346,347	6,085,747	536,152	1,369,262	770,831	2,059,319	3,486	605,661
Total 1945	5.31	4,628,533	12,535,373	3,405,509	9,189,234	770,194	2,052,179	1,088,890	2,998,426		1,022,561
Beehive coke:											
Colorado	1.91	1,737	(2)					1,737	(2)		
Pennsylvania	3.39	73,543	107,587	6,384	14,683			39,516	52,344	24,692	2,951
Utah	2.50	289	(2)					289	(2)		
Virginia	.10	193	1,612			21	165	172	1,447		20
West Virginia	.19	253	(2)					253	(2)		
Undistributed			4,597						4,597		
Total 1946	2.92	76,015	113,796	6,384	14,683	21	165	41,967	58,388	[3] 24,692	2,971

[1] Computed by dividing production of breeze by coal charged at plants actually recovering.
[2] Included under "Undistributed."
[3] As reported; quantity produced but not used was undoubtedly greater. See Mineral Resources of the United States, 1922, pt. II, pp. 726–727.

SHIPMENTS BY RAIL, WATER, AND TRUCK

Tonnages of coke shipped by each of the major methods of transportation for 1946 are summarized in tables 31 and 32. The proportion of all coke shipped by rail, water, and truck in 1946 differed little from 1945. A large part of the oven-coke output is consumed close to the ovens and is not loaded for shipment outside the producing establishment. In 1946 shipments of oven coke represented less than 40 percent of the production. Railroads transported 86 percent of all oven-coke shipments, trucks 10 percent, and boats 4 percent. Nearly all beehive ovens are at the coal mines; consequently, the coke must be loaded for shipment to points of consumption. In 1946 shipments of beehive coke totaled 4,484,615 tons, equivalent to 98 percent of the total beehive output. Water-borne and truck shipments constituted but 2 percent, and the balance moved by rail.

TABLE 31.—Coke and breeze sold and loaded at plant for shipment in 1946, in net tons

State	Coke				Breeze			
	In railroad cars	In boats	In trucks	Total	In railroad cars	In boats	In trucks	Total
Oven coke:								
Alabama	922,885		18,298	941,183	103,339		12	103,351
California	7,005			7,005	7,818			7,818
Colorado	24,171		1,176	25,347	8,172		104	8,276
Illinois	1,538,914		44,932	1,583,846	123,987		1,443	125,430
Indiana	2,136,876		66,050	2,202,926	178,330		295	178,625
Maryland					74,862	53,847		128,709
Massachusetts	528,914	12,336	406,108	947,358			10,321	10,321
Michigan	947,942	74,959	108,380	1,131,281	57,871	18,382	328	76,581
Minnesota	298,560		41,804	340,364	21,883		6	21,889
New Jersey	400,688	316,365	288,294	1,005,347			152	152
New York	2,106,508	95,122	516,907	2,718,537	21,363		5,970	27,333
Ohio	1,851,532	85,826	105,351	2,042,709	98,093	32,740	33	130,866
Pennsylvania	5,404,212	213,795	202,229	5,820,236	69,273	13,216	1,489	83,978
Tennessee	113,592			113,592	12,979			12,979
Utah	75,842		8,261	84,103	29,918		12	29,930
West Virginia	591,052		5,546	596,598	38,005			38,005
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	1,518,781	51,668	362,025	1,932,474	14,623	5,265	19,456	39,344
	18,467,474	850,071	2,175,361	21,492,906	860,516	123,450	39,621	1,023,587
At merchant plants	7,708,992	495,587	1,901,873	10,106,452	177,484	39,179	36,093	252,756
At furnace plants	10,758,482	354,484	273,488	11,386,454	683,032	84,271	3,528	770,831
Beehive coke:								
Colorado	56,198		13	56,211	1,720		17	1,737
Kentucky	85,400			85,400				
Pennsylvania	3,876,623	64,902	5,075	3,946,600	29,785	9,505	226	39,516
Utah	3,759		1,169	4,928	289			289
Virginia	171,247		217	171,464	172			172
West Virginia	219,769		243	220,012	253			253
	4,412,996	64,902	6,717	4,484,615	32,219	9,505	243	41,967

TABLE 32.—Beehive coke loaded for shipment on originating railroads, waterways, and trucks in the United States in 1946, by routes, as reported by producers

Route	Producing State	Net tons		Percent of total
		By States	Total	
Railroads:				
Baltimore & Ohio	Pennsylvania	921,440	1,108,740	24.7
	West Virginia	187,300		
Chesapeake & Ohio	Kentucky	85,400	117,869	2.6
	West Virginia	32,469		
Denver & Rio Grande Western	Colorado	56,198	59,957	1.4
	Utah	3,759		
Interstate	Virginia	146,737	146,737	3.3
Louisville & Nashville	do	1,542	1,542	(1)
Monongahela	Pennsylvania	1,117,669	1,117,669	24.9
Norfolk & Western	Virginia	22,968	22,968	.5
Pennsylvania	Pennsylvania	1,803,086	1,803,086	40.2
Pittsburgh & Lake Erie	do	34,428	34,428	.8
Total railroad shipments		4,412,996	4,412,996	98.4
Waterways:				
Monongahela & Ohio Rivers	Pennsylvania	64,902	64,902	1.5
Trucks	(2)	6,717	6,717	.1
Grand total		4,484,615	4,484,615	100.0

[1] Less than 0.05 percent.
[2] Colorado, Pennsylvania, Utah, Virginia, and West Virginia.

DISTRIBUTION OF OVEN AND BEEHIVE COKE

Table 33 shows the quantity of coke and coke breeze distributed to each State in 1946, with a break-down of the large coke according to principal end uses. This summary was compiled from detailed information submitted by producing companies. It is believed that this distribution summary indicates the approximate size and nature of the market for coke in a given State.

Pennsylvania, the leading coke-producing State, likewise led in tonnage consumed, with 26 percent of the total. Ohio was next, using 16 percent; New York and Indiana followed, with 9 percent each; and Illinois and Alabama consumed 8 and 7 percent, respectively.

Furnace coke was used in 17 States in 1946; however, 78 percent of the total tonnage was used by 5 States—Pennsylvania, Ohio, Indiana, Alabama, and Illinois. Coke for foundry use was shipped into all States but Nevada and Wyoming during 1946. Coke was used in the manufacture of producer gas in 10 States and for producing water gas in 33. Other industrial needs indicated widespread usage throughout the country. Domestic coke was consumed in all but 9 States during 1946. New York, Massachusetts, and Michigan were the principal consumers and together accounted for 45 percent of the total used for this purpose.

An analysis of consumption by principal end uses in 1946 showed that 75 percent of all deliveries were destined to blast furnaces, 5 percent to iron foundries, 7 percent for the manufacture of producer gas and water gas, 4 percent for other industrial purposes, and 9 percent for domestic use.

TABLE 33.—Oven and beehive coke and breeze distributed to each State in 1946, in net tons

[Based upon reports from all United States producers showing destination of coke used by producer or sold in 1946. Does not include imported coke which totaled 52,188 tons in 1946]

Consuming State	Coke							Coke breeze
	Furnace use	Foundry use	Making producer gas	Making water gas	Other industrial use	Domestic use	Total	
Alabama	3,822,221	147,829		920	123,019	75,298	4,169,287	213,706
Arizona		4,622			1,322		5,944	
Arkansas		1,058			269		1,327	106
California	269,607	65,413		33	40,283	5,147	380,483	17,297
Colorado	528,110	13,419			34,559	377	576,465	70,352
Connecticut		43,597	75,566	112,467	7,357	148,229	387,216	49,274
Delaware		3,626		486	582	2,638	7,332	
District of Columbia		46		59,457	588	66	60,157	833
Florida		2,539		44,608	2,433	2,996	52,576	
Georgia		19,657		12,669	12,625	11,165	56,116	4,791
Idaho		424			2,739	69	3,232	105
Illinois	3,985,260	262,867	22,504	51,536	107,637	301,161	4,730,965	353,361
Indiana	4,323,462	156,869	25,656	31,921	179,026	198,094	4,915,028	475,849
Iowa		58,475		1,514	28,853	7,703	96,545	15,314
Kansas		16,554			1,672		18,226	6,637
Kentucky	592,401	26,194		15,945	9,649	34,333	678,522	40,611
Louisiana		7,737			42,049	2,099	51,885	28
Maine		8,425		11,049	2,006	41,563	63,043	
Maryland	1,903,263	47,200		9,248	98,708	5,226	2,063,645	174,266
Massachusetts	10,329	62,692	122,507	140,427	36,252	698,386	1,070,593	126,357
Michigan	1,286,722	451,509		16,712	228,824	474,455	2,458,222	205,858
Minnesota	511,923	38,011	6,918	7,085	32,867	266,025	862,829	83,308
Mississippi		1,819			955	937	3,711	
Missouri		73,294		2,014	42,086	53,330	170,724	10,981
Montana		1,036			31,772		32,808	13,013
Nebraska		3,879		8,474	1,067	467	13,887	114
Nevada					7,064		7,064	
New Hampshire		5,016		637	267	68,642	74,562	
New Jersey		85,881	81,669	332,809	89,374	469,070	1,058,803	130,855
New Mexico		373			404	92	869	
New York	2,711,611	155,534	291,546	993,834	345,365	987,242	5,485,132	450,456
North Carolina		15,728		4,403	5,607	4,995	30,733	662
North Dakota		238		82	300	1,273	1,893	
Ohio	8,088,073	327,659		178,008	241,254	214,450	9,049,444	700,267
Oklahoma		3,604			114		3,718	16,344
Oregon		7,347			8,033		15,380	1,097
Pennsylvania	13,674,523	299,649	68,258	191,693	307,241	290,496	14,831,860	1,115,705
Rhode Island		14,087	33,300	17,045	972	105,134	170,538	24,022
South Carolina		4,567		2,298	1,875	7,567	16,307	7,474
South Dakota		207			237	1,401	1,845	
Tennssee	118,822	88,015		59,848	35,940	5,315	307,940	106,369
Texas		29,606		1,330	44,495		75,431	1,519
Utah	411,281	11,292			46,352	4,637	473,562	98,782
Vermont		6,636		2,803	2,276	23,138	34,853	
Virginia	72,146	42,823		324,425	68,838	1,101	509,333	3,410
Washington		8,190			417		8,607	3,365
West Virginia	1,353,612	76,202		445,775	166,320	3,203	2,045,112	168,660
Wisconsin		144,779	73,429	62,503	11,812	323,888	616,411	82,773
Wyoming					1,255	2	1,257	
	43,663,366	2,846,224	801,353	3,144,058	2,455,011	4,841,410	57,751,422	4,773,921
Exported	37,126	149,978		2,906	190,542	255,323	635,875	29,176
	43,700,492	2,996,202	801,353	3,146,964	2,645,553	5,096,733	58,387,297	4,803,097

CONSUMPTION OF COKE

The indicated consumption of coke in the United States in 1946—allowing for imports, exports, and changes in producers' stocks—decreased 13 percent from 1945 and was 21 percent below the record set in 1944. The drop in consumption in 1946 from the high level of 1944 occurred mainly in the usage of coke in iron blast furnaces and for domestic heating. According to figures compiled by the American Iron and Steel Institute, iron furnaces accounted for 75

percent of the Nation's consumption in 1946 compared with 77 percent in 1945. As shown in table 35 the consumption of coke per ton of metal produced in iron blast furnaces in 1946 increased substantially over the 1945 figures and was the highest since 1927. This increase has been due to a number of variable factors, including the increased ash content of the coke charged into the furnaces.

The quantity of coke consumed in other ways (in foundries, for manufacturing producer gas and water gas, for nonferrous smelting, for miscellaneous industrial and chemical processes, and for household heating) decreased 8 percent below the 1945 total, principally because of the decrease of more than 1,600,000 tons in the consumption of domestic coke. Statistics for the first quarter of 1947 indicate that consumption of coke in iron foundries and in the manufacture of water gas is increasing at the expense of domestic coke.

TABLE 34.—Coke consumed in manufacture of pig iron and for other purposes in the United States, 1913, 1918, 1937, and 1944–46, in net tons

Year	Total production	Imports	Exports	Net change in stocks	Indicated United States consumption [1]	Consumed by iron furnaces [2]		Remainder consumed in other ways	
						Quantity	Percent	Quantity	Percent
1913	46,299,530	101,212	987,395	[3]	45,413,347	37,192,287	81.9	8,221,060	18.1
1918	56,478,372	30,168	1,687,824	[3]	54,820,716	45,703,594	83.4	9,117,122	16.6
1937	52,375,469	286,364	526,683	+863,221	51,271,929	[4]37,599,911	[4]73.3	[4]13,672,018	[4]26.7
1944	74,037,817	63,004	866,835	+262,585	72,971,401	57,071,689	78.2	15,899,712	21.8
1945	67,308,181	51,964	1,478,746	−192,872	66,074,271	50,653,221	76.7	15,421,050	23.3
1946	58,497,848	52,188	1,231,327	−3,047	57,321,756	43,097,749	75.2	14,224,007	24.8

[1] Production plus imports minus exports, plus or minus net changes in stocks.
[2] American Iron and Steel Institute; figures include coke consumed in manufacture of ferro-alloys.
[3] Data not available. [4] Revised figure.

TABLE 35.—Coke and coking coal consumed per net ton of pig iron made in the United States, 1913, 1918, 1937, and 1944–46

Year	Coke per net ton of pig iron and ferro-alloys [1] (pounds)	Yield of coke from coal (percent)	Coking coal per net ton of pig iron and ferro-alloys (pounds calculated)	Year	Coke per net ton of pig iron and ferro-alloys [1] (pounds)	Yield of coke from coal (percent)	Coking coal per net ton of pig iron and ferro-alloys (pounds calculated)
1913	2,172.6	66.9	3,247.5	1944	1,840.6	70.3	2,618.2
1918	2,120.7	66.4	3,193.8	1945	1,870.0	70.4	2,656.3
1937	1,830.6	70.3	2,604.0	1946	1,894.0	70.0	2,705.7

[1] American Iron and Steel Institute; consumption per ton of pig iron only, excluding furnaces making ferro-alloys, was 2,172.6 pounds in 1913, 2,120.7 in 1918, 1,806.7 in 1937, 1,809.8 in 1944, 1,840.0 in 1945, and 1,868.0 in 1946.

Accompanying tables summarize the disposal of coke in 1946 by principal end uses. Statistics on the disposal of coke are indicative of market trends and are of value in planning future expansions in the industry. The pattern in 1946 shows the greatly increased demand for industrial coke and the consequent withdrawal of coke from the domestic market.

The smelting of iron in blast furnaces is the principal branch of consumption of coke in the United States; and, although the tonnage used by producers in integrated blast furnaces and sold for furnace use to affiliated plants and to other purchasers decreased 7,302,429 tons from 1945, the quantity consumed was equivalent to 75 percent of all deliveries. The increased production of steel castings in 1946 caused shipments of foundry coke to reach the highest point since 1926. A drop of 343,683 tons was registered in the coke used for all other industrial purposes (gas manufacture, nonferrous smelting, chemical processes, etc.). Coke grouped under this classification represented 11 percent of the total quantity disposed of in 1946. In 1940, the disposal for other industrial uses constituted only 6 percent of the total. The principal reason for this shift has been the substantial increase in the use of coke for making water gas. Sales of coke for domestic heating were the lowest since 1943 and represented a decline of 25 percent from 1945. Indications are that this downward trend will continue in 1947.

TABLE 36.—Oven coke produced and sold or used by producer in the United States in 1946, by States

[Exclusive of screenings or breeze]

State	Produced		Used by producer—				Sold	
			In blast furnaces		For other purposes [1]		Furnace [2]	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Alabama	4,665,939	$32,669,886	3,760,399	$24,139,583	12,465	$82,688	61,822	$464,016
California	260,470	(3)	268,171	(3)	242	(3)	----------	----------
Colorado	558,545	(3)	528,110	(3)	6,123	(3)	----------	----------
Illinois	3,192,395	32,241,972	1,532,023	15,134,972	79,352	637,636	949,033	9,072,467
Indiana	6,651,567	59,312,827	4,317,649	37,587,221	127,767	988,921	1,493,264	13,057,735
Maryland	1,661,606	(3)	1,642,866	(3)	225	(3)	----------	----------
Massachusetts	1,046,267	(3)	----------	----------	136,155	(3)	8,389	(3)
Michigan	2,499,664	26,191,476	1,196,010	(3)	147,845	1,330,921	146,118	(3)
Minnesota	860,754	8,468,220	510,735	(3)	9,753	62,926	----------	----------
New Jersey	1,258,854	(3)	----------	----------	237,795	(3)	----------	----------
New York	5,042,674	44,316,777	1,171,253	(3)	1,108,874	8,033,073	1,333,909	10,599,741
Ohio	8,451,580	69,357,225	6,249,732	50,090,917	89,206	912,079	886,997	7,254,647
Pennsylvania	12,794,721	90,189,945	6,801,816	53,144,366	135,383	1,057,211	4,833,684	26,098,814
Tennessee	229,751	(3)	117,271	(3)	----------	----------	----------	----------
Utah	487,133	(3)	391,547	(3)	7,788	(3)	17,649	(3)
West Virginia	2,162,453	12,190,707	1,217,798	(3)	356,460	(3)	409,164	2,495,174
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	2,105,074	21,026,086	----------	----------	196,517	1,605,576	560,658	3,908,478
Undistributed	----------	54,095,091	----------	62,080,062	----------	5,841,772	----------	1,607,857
Total 1946	53,929,447	450,060,212	29,705,380	242,177,121	2,651,950	20,552,803	10,700,676	74,558,929
At merchant plants	12,388,485	122,963,480	----------	----------	2,354,146	18,155,950	1,489,098	12,823,410
At furnace plants	41,540,962	327,096,732	29,705,380	242,177,121	297,804	2,396,853	9,211,578	61,735,519
Total 1945	62,094,288	470,190,338	34,365,834	256,729,973	2,803,736	19,568,952	12,544,788	81,414,131

See footnotes at end of table.

TABLE 36.—Oven coke produced and sold or used by producer in the United States in 1946, by States—Continued

State	Sold-Continued							
	Foundry [3]		Domestic		Industrial and other (including water gas) [4]		Total	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Alabama	379,214	$4,040,354	129,369	$894,505	370,778	$3,350,259	941,183	$8,749,134
California	----------	----------	5,147	(5)	1,858	(5)	7,005	(5)
Colorado	937	(5)	507	(5)	23,903	(5)	25,347	(5)
Illinois	314,565	4,178,697	239,496	2,470,487	80,763	772,144	1,583,846	16,493,795
Indiana	364,012	(5)	236,625	1,829,143	109,025	(5)	2,202,926	20,741,246
Maryland	----------	----------	----------	----------	----------	----------	----------	----------
Massachusetts	81,729	(5)	706,682	(5)	150,558	(5)	947,358	(5)
Michigan	414,473	(5)	431,875	4,113,303	138,815	1,412,704	1,131,281	12,355,644
Minnesota	12,538	(5)	281,361	3,305,394	46,465	(5)	340,364	4,018,279
New Jersey	49,548	(5)	557,367	(5)	398,432	(5)	1,005,347	(5)
New York	29,499	(5)	911,668	8,543,947	443,461	(5)	2,718,537	23,597,564
Ohio	255,878	3,121,654	258,629	1,983,952	641,205	5,482,588	2,042,709	17,842,841
Pennsylvania	216,499	2,707,352	449,240	3,924,589	320,813	2,995,913	5,820,236	35,726,668
Tennessee	37,864	(5)	----------	----------	75,728	(5)	113,592	(5)
Utah	----------	----------	4,706	(5)	61,748	(5)	84,103	(5)
West Virginia	79,004	(5)	30,111	205,041	78,319	(5)	596,598	4,092,895
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	337,908	4,572,940	704,302	7,724,891	329,606	3,449,908	1,932,474	19,656,217
Undistributed	----------	13,836,553	----------	13,982,602	----------	13,308,746	----------	23,492,312
Total 1946	2,573,668	32,457,550	4,947,085	48,977,854	3,217,477	30,772,262	21,492,906	186,766,595
At merchant plants	2,021,463	25,625,263	3,907,557	41,221,515	2,688,334	25,892,929	10,106,452	105,563,117
At furnace plants	552,205	6,832,287	1,039,528	7,756,339	583,143	4,879,333	11,386,454	81,203,478
Total 1945	2,338,033	26,833,646	6,574,526	57,124,329	3,479,261	28,643,684	24,936,608	194,015,790

[1] Comprises 68,539 tons valued at $669,345 used in foundries; 801,353 tons ($5,956,376) to make producer gas; 1,429,785 tons ($11,012,922) to make water gas; and 352,273 tons ($2,914,160) for miscellaneous purposes.
[2] Includes 8,791,275 tons valued at $57,666,275 sold to financially affiliated plants.
[3] Includes 2,344 tons valued at $16,213 sold to financially affiliated plants.
[4] Includes 583, 904 tons valued at $5,230,353 for manufacture of water gas and 186,906 tons ($1,585,360) for other industrial use sold to financially affiliated plants; and 942,837 tons ($9,198,354) for manufacture of water gas sold to other consumers.
[5] Included under "Undistributed."

TABLE 37.—Beehive coke produced and sold or used by producer in the United States in 1946, by States

State	Produced		Used by producer—				Sold	
			In blast furnaces		For other purposes		Furnace [1]	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Colorado	58,761	(2)						
Kentucky	85,400	(2)					67,186	(2)
Pennsylvania	4,027,167	$31,627,135	51,367	$581,918	937	$9,478	3,104,010	$23,404,994
Utah	5,234	(2)					3,400	(2)
Virginia	171,242	1,619,144					44,532	426,185
West Virginia	220,597	1,913,713			142	1,292	23,941	194,717
Undistributed		1,509,178						728,102
Total: 1946	4,568,401	36,669,170	51,367	581,918	1,079	10,770	3,243,069	24,753,998
1945	5,213,893	38,349,703	240,547	1,884,251	76,435	718,976	3,851,752	27,630,827

State	Sold—Continued							
	Foundry		Domestic		Industrial and other (including water gas) [3]		Total	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Colorado	346	(2)			55,865	(2)	56,211	(2)
Kentucky					18,214	(2)	85,400	(2)
Pennsylvania	292,421	$2,686,526	127,531	$1,004,734	422,638	$3,618,649	3,946,600	$30,714,903
Utah	431	(2)			1,097	(2)	4,928	(2)
Virginia	26,378	270,861	2,340	19,586	98,214	905,313	171,464	1,621,945
West Virginia	34,419	336,656	19,777	161,930	141,875	1,214,643	220,012	1,907,946
Undistributed		8,030				744,024		1,480,156
Total: 1946	353,995	3,302,073	149,648	1,186,250	737,903	6,482,629	4,484,615	35,724,950
1945	254,762	2,155,918	200,982	1,461,402	622,057	4,755,292	4,929,553	36,003,439

[1] Includes 1,210,447 tons valued at $8,278,178 sold to financially affiliated plants for blast-furnace use.
[2] Included under "Undistributed."
[3] Includes 53,939 tons valued at $549,481 sold to financially affiliated plants for other industrial use and 190,438 tons ($1,652,029) for manufacture of water gas.

STOCKS OF COKE AND COKING COAL

Coke.—Year-end stocks of oven coke at producers' plants totaled 892,913 tons, a decrease of 34,086 tons from 1945. Stocks of furnace coke increased slightly, but the gain was offset by decreases in stocks of foundry, domestic, and other coke. Total reserves of oven coke at the end of the year were equivalent to but 5.8 days' production at the rate prevailing in December 1946. Producers' stocks of beehive coke, which normally are very small, increased 31,039 tons during the year and on January 1, 1947, totaled 35,853 tons, equivalent to only 2.8 days' production at the December rate.

Coal.—Stocks of coking coal at oven-coke plants in most of 1946 were at dangerously low levels. The highest reserves were 8,269,360 tons at the end of March, the lowest supply 2,565,010 tons at the end of May. Under normal operating conditions, the stocks on May 31 on an industry-wide basis were equivalent to a 10 days' supply. However, monthly reports received by the Bureau of Mines from coke producers indicated that on that date 13 plants (including some of the largest steel producers) had less than 5 days' supply, 22 less than 10

days' supply, and the balance over 10 days' supply. Although stocks increased steadily during the summer months, mine stoppages in November-December curtailed the flow of coal to oven-coke plants, and the tonnage on hand at the end of the year was far short of the reserves normally carried by the operators.

TABLE 38.—Summary of total stocks of coke on hand at all coke plants in the United States on Jan. 1, 1937 and 1943–47, in net tons

[Exclusive of screenings or breeze]

	1937	1943	1944	1945	1946	1947
Oven-coke plants:						
Furnace	282,144	770,135	517,452	478,133	425,438	445,763
Foundry	8,981	21,937	21,490	18,265	24,509	12,565
Domestic and other	1,408,350	661,401	286,671	590,048	477,052	434,585
	1,699,475	1,453,473	825,613	1,086,446	926,999	892,913
Beehive-coke plants:						
Furnace	5,622	24,617	30,740	33,649	2,455	30,750
Foundry	8,508	2,203	482	766	270	1,508
Domestic and other	18,461	8,756	5,265	3,824	2,089	3,595
	32,591	35,576	36,487	38,239	4,814	35,853
Total:						
Furnace	287,766	794,752	548,192	511,782	427,893	476,513
Foundry	17,489	24,140	21,972	19,031	24,779	14,073
Domestic and other	1,426,811	670,157	291,936	593,872	479,141	438,180
	1,732,066	1,489,049	862,100	1,124,685	931,813	928,766

TABLE 39.—Stocks of furnace, foundry, and domestic coke and of breeze in the United States on Jan. 1, 1947, by States, in net tons

State	Coke				Breeze
	Furnace	Foundry	Domestic and other	Total	
Oven coke:					
Alabama	61,436	4,347	5,092	70,875	11,765
California	1,398		3,136	4,534	32,939
Colorado	2,760			2,760	2,145
Illinois	20,716	799	2,856	24,371	71,060
Indiana	57,139	1,482	18,733	77,354	48,912
Maryland	27,798			27,798	193,584
Massachusetts	464	329	64,215	65,008	9,042
Michigan	6,383	1,341	3,571	11,295	13,483
Minnesota	1,014		36,471	37,485	42,083
New Jersey			36,998	36,998	10,687
New York	27,032	25	166,202	193,259	50,168
Ohio	124,086	2,376	9,859	136,321	101,932
Pennsylvania	96,435	393	22,113	118,941	71,703
Tennessee	1,174	909	1,685	3,768	
Utah	10,826		18,013	28,839	7,816
West Virginia	5,860	187	11,038	17,085	30,113
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	1,242	377	34,603	36,222	14,820
	445,763	12,565	434,585	892,913	712,252
At merchant plants	9,257	9,630	331,818	350,705	106,591
At furnace plants	436,506	2,935	102,767	542,208	605,661
Beehive coke:					
Colorado			2,550	2,550	
Pennsylvania	30,045	798	854	31,697	2,951
Utah		489		489	
Virginia	705	9	178	892	20
West Virginia		212	13	225	
	30,750	1,508	3,595	35,853	2,971

TABLE 40.—Stocks of oven coke at furnace and merchant plants in the United States on first of each month, 1945–46, in net tons

[Includes furnace, foundry, and domestic, but not breeze]

Month	Furnace plants		Merchant plants		Total	
	1945	1946	1945	1946	1945	1946
January	589, 524	498, 835	496, 922	428, 164	1, 086, 446	926, 999
February	609, 395	671, 589	303, 905	298, 772	913, 300	970, 361
March	584, 028	940, 316	194, 514	220, 585	778, 542	1, 160, 901
April	498, 917	813, 555	177, 696	202, 506	676, 613	1, 016, 061
May	428, 898	441, 606	204, 350	178, 262	633, 248	619, 868
June	514, 423	292, 195	209, 734	172, 477	724, 157	464, 672
July	597, 533	360, 380	274, 880	255, 881	872, 413	616, 261
August	568, 924	361, 157	357, 388	347, 783	926, 312	708, 940
September	674, 026	397, 698	428, 376	408, 831	1, 102, 402	806, 529
October	658, 483	502, 514	518, 285	446, 437	1, 176, 768	948, 951
November	481, 371	652, 935	482, 032	467, 326	963, 403	1, 120, 261
December	489, 767	602, 497	512, 256	431, 576	1, 002, 023	1, 034, 073

TABLE 41.—Stocks of bituminous coal at oven-coke plants in the United States at end of each month, 1937 and 1944–46, in net tons

Month	1937	1944	1945	1946
January	8, 030, 871	6, 137, 165	5, 694, 501	5, 665, 131
February	8, 687, 389	6, 382, 553	5, 610, 111	6, 392, 605
March	9, 638, 317	6, 280, 880	5, 452, 042	8, 269, 360
April	8, 543, 774	5, 929, 623	4, 456, 204	4, 116, 899
May	8, 187, 883	5, 891, 893	4, 428, 452	2, 565, 010
June	7, 770, 256	6, 127, 041	5, 128, 071	3, 629, 535
July	7, 432, 741	5, 708, 408	4, 752, 624	3, 871, 156
August	7, 455, 932	5, 927, 586	4, 502, 647	5, 229, 600
September	7, 760, 533	6, 173, 834	4, 624, 488	5, 925, 815
October	8, 066, 938	6, 396, 922	3, 665, 833	6, 593, 083
November	8, 114, 094	6, 737, 442	4, 607, 047	6, 355, 321
December	7, 273, 403	6, 111, 538	4, 873, 546	5, 238, 762

VALUE AND PRICE

The average realization figures used in this report represent the value of coke at the ovens, as reported by coke producers. The greatest part of the coke produced in the United States is made in ovens operated by corporations which not only mine the coal they use, but also operate blast furnaces that consume the bulk of the output of their ovens. Under such conditions, fixing a value for coal charged and for coke produced is purely arbitrary. For example, at some establishments the cost of coke to the furnace department equals the cost of production; at others a margin of profit is added; or the cost is considered to be the market value.

The total value of all coke produced, by States, is shown in table 3; it was 4 percent lower than in 1945. Pennsylvania led all States in dollar value and tonnage produced, accounting for one-fourth of the total value of the oven- and beehive-coke output.

The average receipts per ton of coke sold in 1946 increased sharply over those of the preceding year because of higher coal and labor costs. Receipts per ton of oven coke sold in 1946 increased over 1945 as follows: Furnace, $0.98; foundry, $1.14; domestic, $1.21; and other industrial, $1.23. Average sales realization for beehive coke showed the following price increases per ton over 1945: $0.73 for furnace; $0.87 for foundry; $0.66 for domestic; and $1.03 for other industrial.

TABLE 42.—Average value per net ton of coke produced and average receipts per net ton from coke sold in the United States, 1936–46

Year	Value per ton produced			Receipts per ton sold		
	Oven coke	Beehive coke	Total	Oven coke	Beehive coke	Total
1936	$5.06	$3.91	$5.02	$5.83	$3.92	$5.65
1937	5.03	4.31	4.98	6.11	4.23	5.83
1938	5.16	4.42	5.14	6.00	4.27	5.90
1939	4.82	4.45	4.80	5.75	4.31	5.63
1940	4.82	4.41	4.80	5.87	4.34	5.68
1941	5.41	5.44	5.41	6.71	5.54	6.42
1942	6.07	5.75	6.03	7.33	5.75	6.87
1943	6.65	6.55	6.64	6.93	6.53	6.85
1944	7.14	7.04	7.13	7.46	6.97	7.36
1945	7.57	7.36	7.56	7.78	7.30	7.70
1946	8.35	8.03	8.32	8.69	7.97	8.56

TABLE 43.—Average receipts per net ton of coke sold (merchant sales) in the United States in 1946, by States

State	Oven coke				Beehive coke			
	Furnace	Foundry	Domestic	Other industrial, including water gas	Furnace	Foundry	Domestic	Other industrial, including water gas
Alabama	$8.85	$10.65	$6.91	$9.04				
California, Colorado, and Utah		(1)	4.75	8.96	(1)	(1)		(1)
Connecticut, Massachusetts, and Rhode Island		13.59	11.25	10.37				
Illinois	10.67	13.29	10.32	9.61				
Indiana	10.15	(1)	7.73	(1)				
Kentucky, Missouri, and Tennessee	6.97	12.35	8.66	9.84	(1)			(1)
Maryland								
Michigan, Minnesota, and Wisconsin	9.28	13.42	10.59	10.56				
New Jersey and New York	9.75	13.69	9.97	9.80				
Ohio	8.56	12.21	7.67	8.60				
Pennsylvania	9.49	12.55	8.74	9.43	$7.99	$9.19	$7.88	$8.56
Virginia					9.57	10.27	8.37	9.22
West Virginia	7.91	(1)	6.81	(1)	8.13	9.78	8.19	8.56
Undistributed		12.64		8.80	10.32	(2)		9.16
United States average	8.85	12.62	9.90	9.58	8.11	9.33	7.93	8.67
At merchant plants	8.58	12.68	10.55	9.91				
At furnace plants	9.78	12.40	7.46	8.44				

[1] Included under "Undistributed."
[2] Not published to avoid disclosure of individual operations.

FOREIGN TRADE

Exports.—The demand for coke in virtually all foreign countries in 1946 exceeded the supply, and exports from the United States would have been much greater had more coke been available in this country. Exports of coke in 1946 totaled 1,231,327 tons valued at $12,635,593, a decrease of 17 percent in quantity but an increase of 0.3 percent in value. As in previous years, Canada was the principal

foreign market for American coke, receiving 71 percent of all exports. Exports to Canada, however, were 33 percent below the 1945 total, principally because of the decline in reclaimed beehive-coke shipments to that country and the increase in shipments of industrial coke to Europe. Shipments to Europe were made to alleviate acute shortages of coke in countries that depended on German coke before and during World War II. It is to be noted that shipments to Sweden exceeded those to any country other than Canada and amounted to more than a quarter of a million tons, most of which was shipped during the steel strike in this country.

Imports.—Imports of coke, all of which came from Canada, into continental United States increased only 224 tons over 1945. Coke imports supply but a minute part of the Nation's requirements and are restricted to a few localities. More than 77 percent of the total tonnage imported in 1946 entered through the Montana-Idaho customs district.

TABLE 44.—Coke exported from the United States, 1944–46, by countries and customs districts

	1944		1945		1946	
	Net tons	Value	Net tons	Value	Net tons	Value
COUNTRY						
North America:						
Canada	820,434	$6,604,080	1,305,390	$10,519,110	875,110	$8,182,362
Mexico	6,813	68,272	8,116	60,471	5,496	50,761
Panama, Republic of	3	45	3	89	10	244
West Indies:						
Cuba	15,724	226,577	27,971	341,794	13,810	171,204
Trinidad and Tobago	1,070	17,335	435	6,788		
Other North America	1,243	28,426	1,068	25,575	833	19,330
South America:						
Argentina	1,765	22,883	2,384	21,323	471	9,198
Bolivia	284	6,657	609	12,887	727	16,900
Brazil	6,760	106,583	6,287	110,492	9,536	186,711
Chile	10,720	216,768	7,043	130,160	5,005	91,518
Peru	333	6,011	1,033	27,444	622	14,475
Uruguay			463	5,680	1,285	26,388
Venezuela	430	10,755	1,016	25,920	1,047	25,188
Other South America	133	2,274	226	3,965	216	5,752
Europe:						
Denmark			15,462	178,423	868	9,829
Finland					15,200	203,148
France			10,411	106,564	125	3,198
Italy			7,514	21,942	7,482	80,414
Netherlands					5,456	103,363
Portugal			2,109	31,413	8,948	113,779
Spain	986	13,977				
Sweden			78,829	939,479	254,190	3,016,325
Switzerland			1,631	18,739	1,010	11,550
Yugoslavia					21,771	232,449
Other Europe					6	402
Asia:						
China					766	18,105
Philippines, Republic of			134	4,920	1,336	42,964
Africa:						
Morocco, French			608	7,449		
Other Africa	137	3,666	4	80		
Oceania: French Pacific Islands					1	36
	866,835	7,334,309	1,478,746	12,600,707	1,231,327	12,635,593

TABLE 44.—Coke exported from the United States, 1944–46, by countries and customs districts—Continued

	1944		1945		1946	
	Net tons	Value	Net tons	Value	Net tons	Value
CUSTOMS DISTRICT						
Buffalo	420,203	$2,950,673	718,940	$5,236,382	600,443	$5,322,030
Chicago	5,843	45,494	21,602	144,597	9,015	80,871
Dakota	16,045	156,320	18,324	179.803	11,929	121,830
Duluth and Superior	7,775	80,109	8,916	92,778	10,081	105,766
Florida	17,455	251,799	1,805	25,404	5,914	74,530
Laredo	1,796	18,447	2,582	29,996	1,914	24,061
Maryland	4,454	57,674	34,902	425,592	209,234	2,431,856
Michigan	311,003	2,880,247	298,258	2,819,844	215,659	2,299,621
Mobile	668	8,038	37,105	446,198	7,159	86,413
New Orleans	10,359	199,104	18,385	316,559	29,856	503,974
New York	4,321	111,633	2,587	62,264	3,258	79,772
Ohio	24,200	184,702	38,183	301,685	11,182	77,760
Philadelphia	986	13,977	60,319	614,704	65,730	802,597
St. Lawrence	29,497	250,425	183,341	1,640,091	11,949	97,257
San Diego	520	7,065	180	2,696	414	6,960
San Francisco	64	2,537	159	5,743	1,816	59,191
Virginia	1,476	22,060	10,136	128,905	27,819	369,663
Other districts	10,170	94,005	23,022	127,466	7,955	91,441
	866,835	7,334,309	1,478,746	12,600,707	1,231,327	12,635,593

TABLE 45.—Coke imported for consumption in the United States, 1944–46, by countries and customs districts [1]

	1944		1945		1946	
	Net tons	Value	Net tons	Value	Net tons	Value
CUSTOMS DISTRICT						
Buffalo	23,181	$421,160	19,367	$320,944	9,951	$167,434
Dakota					34	343
Maine and New Hampshire	293	2,768	350	3,147	544	5,419
Michigan					179	1,305
Minnesota					220	441
Montana and Idaho	38,345	298,653	30,614	236,808	40,428	309,307
New York					683	21,097
Ohio			1	7		
St. Lawrence	17	181				
Vermont	98	983	118	1,087	116	1,130
Washington	1,070	6,905	1,514	11,396	33	308
Total coke imported [1]	63,004	730,650	51,964	573,389	52,188	506,784

[1] All from Canada, 1944–46.

TECHNOLOGIC DEVELOPMENTS

Although no spectacular new developments were reported in coal carbonization during 1946, considerable scientific and technologic work was accomplished by Government and State agencies, coal-research laboratories, and individual companies.

The Bureau of Mines, which has conducted scientific and technologic investigations on coal and related products since its creation by Congress in 1910, continued its research work in these fields of endeavor in 1946. Information on processes and changes in equipment used in the Bureau of Mines-American Gas Association method for experimentally determining the carbonizing properties of American

coals was brought up to date and published.[4] Results of the work accomplished by the Bureau in 1946 on the composition and carbonizing properties of various American coals were described in various published reports.[5] A report summarizing the results of several surveys made by Bureau engineers during the war years on bulk density control of coke-oven charges were published in 1946.[6] An excellent summary of the outstanding technologic developments in the coke industry during World War II was prepared by Seymour[7] describing methods of determining the suitability of a coal for coke production, coal handling and preparation at oven-coke plants, and recent improvements in the design of coke ovens. A convenient method for ascertaining the free-swelling index of coal whose coke buttons do not conform to any of the standard profiles was described by Selvig and Ode[8] in a report released in 1946. This method has proved of value for obtaining information regarding the coking properties of coal on fuel beds but is not recommended for measuring the amount of expansion or contraction that takes place during carbonization of coal in coke ovens.

A method for recovery of pyridine bases—one of the most recent groups of coal chemicals to be recovered at coke plants—was developed by Herbert L. Stewart and described in United States Patent 2,410,906 issued November 12, 1946, and assigned to the Koppers Co., Inc.

WORLD PRODUCTION

The accompanying table gives available figures on production of coke in various countries in recent years and an estimate of the world total. The present lack of production statistics from some of the large coke-producing countries makes it impossible to prepare a completely accurate statement of world output.

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[5] Reynolds, D. A., Davis, J. D., Ode, W. H., Brewer, R. E., and Birge, G. W., Carbonizing Properties of Eagle-Bed Coal from Prospect Shaft, Carbon, Kanawha County, W. Va., Bureau of Mines Tech. Paper 691, 1946, 43 pp.

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[6] Auvil, H. S., Schmidt, L. D., and Graham, H. G., Control of Bulk Densities in Coke Ovens—Studies on Precision and Application of Various Testing Methods: Bureau of Mines Rept. of Investigations 3935, 1946, 21 pp.

[7] Seymour, William, Wartime Progress in Coke Production: Bureau of Mines Rept. of Investigations 3907, 1946, 13 pp.

[8] Selvig, W. A., and Ode, W. H., An Investigation of a Laboratory Test for Determination of the Free-Swelling Index of Coal: Bureau of Mines Rept. of Investigations 3989, 1946, 8 pp.

TABLE 46.—Coke produced in principal countries of the world, 1938 and 1940–46, in metric tons [1] [2]

[Compiled by P. Roberts]

Country	1938	1940	1941	1942	1943	1944	1945	1946
Australia:								
New South Wales	1,153,670	1,292,484	1,738,864	1,644,897	1,592,325	1,402,310	1,061,822	[3]
Queensland	31,481	21,961	30,991	22,529	15,304	14,637	15,903	13,757
Austria	[3]	[3]	[3]	[3]	[3]	618,949	69,600	138,000
Belgium	4,894,980	3,945,280	4,425,180	4,407,080	4,410,940	2,047,290	2,060,160	3,856,729
Brazil		9,912	21,068	10,267	19,845	[3]	[3]	[3]
Bulgaria	3,923	6,000	[3]	[3]	[3]	[3]	[3]	[3]
Canada	1,808,588	2,321,775	2,431,942	2,536,165	2,709,354	3,217,107	3,008,050	2,585,493
China	[4] 11,630	[5] 247,394	[5] 318,445	[5] 388,734	[5] 379,822	[5] 302,466	44,000	95,910
Czechoslovakia	2,766,000	3,733,000	3,696,000	3,889,000	4,280,000	4,528,000	[3]	[3]
France	7,636,150	5,161,570	4,892,860	5,008,360	4,989,580	2,908,655	2,505,972	4,959,889
Germany [6]	40,404,082	46,931,593	47,636,121	47,996,026	[7] 49,457,000	[7] 49,866,000	[3]	[3]
Saar	3,107,000	1,762,293	3,264,830	3,241,439	[7] 3,304,000	[7] 3,534,000	[3]	[3]
Great Britain [8]	13,031,396	15,597,384	14,780,479	15,139,145	14,683,955	14,307,360	14,210,170	14,211,085
Hungary	53,092	[3]	[3]	[3]	[3]	[3]	[3]	[3]
India	1,738,178	1,872,810	1,999,436	1,882,533	1,578,137	1,406,299	[3]	[3]
Indochina, French	3,503	2,600		4,400	5,300	2,700	[3]	[3]
Italy	1,739,417	1,987,903	1,833,388	1,668,188	[9] 2,000,000	[3]	[3]	[3]
Japan [10]	3,724,000	4,591,000	5,222,000	5,842,000	4,801,000	3,759,000	[3]	[3]
Korea (Chosen)	377,937	361,961	399,860	582,918	851,307	733,216	[11] 91,541	[11] 40,000
Netherlands	3,158,065	2,367,000	[3]	[7] 1,937,000	1,901,000	[3]	[3]	[3]
New Caledonia	49,875	69,762	99,700	83,661	[3]	[3]	[3]	[3]
Peru		[3]	[3]	[3]	[3]	[3]	18,046	
Poland	2,523,290	[3]	[3]	[3]	2,300,000	[3]	1,743,239	2,146,852
Rumania	86,030	85,623	84,741	86,115	84,212	[3]	[3]	[3]
Southern Rhodesia	47,986	59,060	81,016	71,402	78,566	79,857	85,103	[3]
Spain	571,469	839,744	753,108	814,355	801,122	862,574	909,000	764,600
Sweden	112,107	100,753	[3]	[3]	81,617	[3]	[3]	[3]
Turkey	84,930	60,192	61,086	81,950	90,000	212,000	59,883	43,003
Union of South Africa	163,315	221,885	226,503	232,498	240,724	176,524	[3]	[3]
U. S. S. R.	20,700,000	16,500,000	[3]	[9] [12] 6,085,000	[9] [12] 7,801,000	[9] 9,915,000	[9] 13,000,000	[3]
United States	29,479,553	51,774,699	59,135,960	64,018,735	65,023,091	67,165,627	61,060,636	53,068,078
Total [13]	139,837,000	164,901,000	167,204,000	170,744,000	174,114,000	173,435,000	114,948,000	117,438,000

[1] Gas-house coke not included.
[2] In addition to countries listed coke is produced in Mexico and New Zealand, but data are not available.
[3] Data not available.
[4] Exports.
[5] Data represents areas designated as Free China during the period of Japanese occupation.
[6] Beginning October 1939, Silesian production included.
[7] Coal year ended March 31 of year stated.
[8] In Great Britain production of gas-house coke, not included, is especially important and was 10,770,130 tons in 1938, and averaged 11,000,000 tons per year for 1940 to 1944, inclusive. Data for 1945 and 1946 are not available.
[9] Estimate.
[10] Preliminary data for fiscal year ended March 31 of year following that stated.
[11] South Korea only.
[12] Production of Siberia and Urals only. [13] Estimated by author of chapter. Excludes estimates for countries listed in footnote 2.

COAL-CHEMICAL MATERIALS

GENERAL SUMMARY

Coke-oven gas, tar, ammonia, and light oil are the principal groups of coal-chemical materials, but the term also includes fractions and individual compounds recovered from these groups. Technologic developments in recent years in the manufacture of plastics, synthetic rubber, aviation gasoline, explosives, dyes, pharmaceutical preparations, and synthetic drugs have broadened the range of application and markets for benzol, toluol, xylol, solvent naphtha, naphthalene, phenol, cresylic acid, and pyridine. The tendency in the coke industry is toward the production of the more highly refined and pure aromatic hydrocarbon products and the development of related and new compounds. A striking example is the shift from the manufacture of "motor benzol" to the 1° and 2° grades. In the year preceding

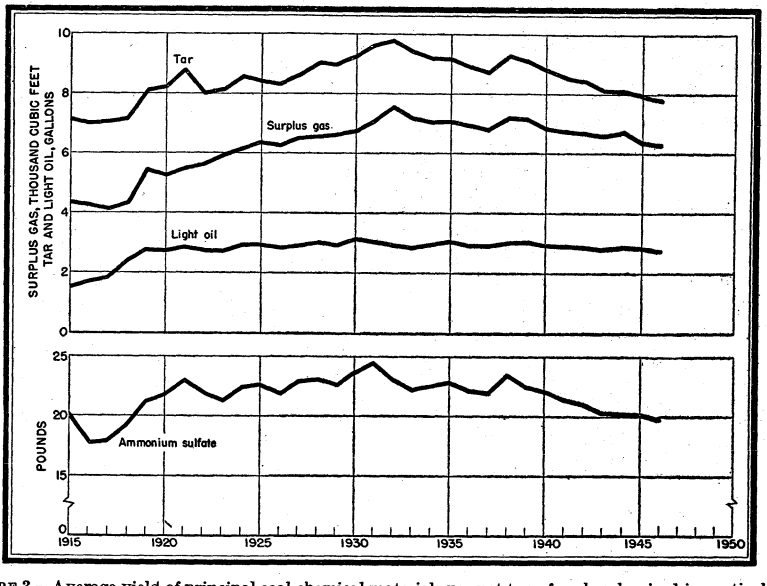

FIGURE 3.—Average yield of principal coal-chemical materials per net ton of coal carbonized in vertical slot-type ovens, 1915–46. Yields of light oil and ammonium-sulfate equivalent represent average for plants recovering these products.

World War II, more than 76 percent of the benzol produced at coke plants was "motor benzol," whereas only 20 percent of this grade was produced in 1946. The forerunnings from the distillation of crude light oil are now being processed by three producers for the manufacture of dicyclopentadiene. It is likely that production of this chemical compound will increase in future because of its many versatile uses. The pyridine bases are one of the most recent groups of coal chemicals to be recovered from coke-oven gas. In 1946, 32 plants were recovering pyridine bases. Recovery of these bases, in connection with ammonia recovery in sulfate saturators, has proved profitable, and their removal does not appreciably affect the quality of the gas. Ammonium thiocyanate is another compound that is being recovered

in concentrated solution at several coke plants by scrubbing the gas with a suspension of sulfur before it enters the saturators. The more efficient utilization of coal tar for the recovery of tar products is indicated by the decline in its use as fuel from 50 percent of the production in 1929 to 13 percent in 1946. Separation of the miscellaneous chemical compounds, such as phenol, cresols, and cresylic acid, from tar distillates at coke plants is increasing, but statistics cannot be published because less than three companies are currently involved.

Due to the increased demand for coal chemicals, coke-plant operators are placing more emphasis on their recovery, and efforts are being made to increase the financial returns from them. It is significant to note that the proportion of revenue obtained from sales of all chemical materials has not paced that received from coke. Total realization from sales of all coal-chemical materials in 1946 was equivalent to 35 percent of the value of oven coke produced, compared with 50 percent in 1941 and 64 percent in 1929. Table 47 summarizes statistics on the coal-chemical materials obtained from coke-oven operation in 1946, and figure 3 illustrates the trend in the yield of the various products.

Gas.—Production of coke-oven gas in 1946 decreased 13 percent from the 1945 output. Next to coke, gas is the most valuable product obtained in the carbonization process, and in 1946 it contributed more then 50 percent of the total revenue obtained from the sales of all coal-chemical materials. In addition to providing the fuel requirements of the ovens from which it is evolved, coke-oven gas supplies various other fuel needs. During 1946, 480,489,586 M cubic feet (61 percent of the 783,637,016 M cubic feet of gas produced) were sold or used for industrial purposes and for distribution through city mains. Of the 480,489,586 M cubic feet sold or used, 6 percent was used by producers under boilers, 55 percent in integrated metallurgical operations, 6 percent was sold to neighboring industries, and 33 percent was sold for distribution through city mains. The average unit value as reported by operators was $0.173 per M cubic feet—an increase of $0.015 over the 1945 figure of $0.158. This increase was due in part to general increases in the prices on gas sold or used for all purposes and also to the larger proportion of surplus gas distributed through city mains, as this gas always commands higher prices than that used or sold for industrial purposes.

Crude Coal Tar and Derivatives.—The yield of crude coal tar per ton of coal carbonized decreased in 1946 for the second consecutive year. The substantial drop in coal charged into coke ovens, coupled with the decreased yield, caused production of this coal product to decline 14 percent from 1945. The principal uses for tar are (1) as a raw material in manufacture of coal-tar products, (2) as a metallurgical fuel in steel making, and (3) as a fuel for boilers.

Before World War II, roughly 60 percent of the crude tar produced in coke plants was refined, and the balance was used directly as fuel, largely in steel-plant operations. The demand for coal-tar products during and since the war changed this practice greatly, and in 1946 the proportion of crude coal tar used as fuel was the lowest on record. Producers reported that 26 percent of the production was processed in integrated refining facilities and 61 percent was sold to other purchasers for refining. The substitution of fuel oil and residual tar and

pitches from tar-topping operations in recent years has been an important factor in lowering the consumption of crude tar in metallurgical operations.

The principal coal-tar product produced by coke-oven operators is creosote oil, a derivative used mainly for impregnating lumber. Although production of this material declined 16 percent from 1945, total realization from sales was equivalent to 54 percent of the total revenue received by coke-plant operators from the sale of all coal-tar products. Production and sales of tar-acid oil decreased 6 and 3 percent, respectively, from 1945. Pitch output also dropped markedly in 1946. The marketing of pitch produced at coke plants has not been developed extensively, and in 1946 approximately 99 percent of the output was used by the producers. The soft and medium pitches are cut back (usually with virgin tar) to the desired viscosity and used as metallurgical fuel, and the hard pitch produced at several plants is mixed with the coal before being charged into the ovens for improving coke quality. As stated in the previous discussion, statistics on cresols, cresylic acid, and phenol cannot be published because less than three producers are involved.

Ammonia.—Ammonia was recovered at 81 of the 85 active coke plants in 1946, 64 of which made ammonium sulfate and 21 ammonia liquor (4 plants produced both sulfate and liquor). The total production of ammonia (NH_3 equivalent of all forms) decreased 15 percent from 1945, a reduction resulting from decreases of 16 and 10 percent, respectively, in the output of sulfate of ammonia and ammonia liquor. As in previous years, approximately 87 percent of the total ammonia recovered was converted to ammonium sulfate, which was virtually all used as a fertilizer. Sales of ammonium sulfate followed production closely, decreasing 20 percent in quantity and 12 percent in value from 1945. The average unit value on sales as reported by operators was $0.014 a pound—an increase of $0.001 per pound over 1945. This was due to the increases granted to producers in all but 11 Western States by the Office of Price Administration on July 26, 1946, raising the price, f. o. b. point of production, from $28.00 per ton, bulk, to $30.00 per ton. Although price ceilings on ammonium sulfate were abolished in November by the OPA decontrol order, quotations reported in various trade journals indicated that prices did not increase during the remainder of the year.

Crude Light Oil and Derivatives.—In 1946 the output of crude light oil—a term used in the coke industry to designate the mixture of all those condensible products derived from the coking process whose boiling points do not exceed 200° C.—decreased 16 percent from 1945. The yield of crude light oil per ton of coal carbonized dropped from 2.84 gallons in 1945 to 2.77 gallons and was the lowest since 1933. The processing of crude light oil is widely practiced by coke-plant operators, and in 1946 fully 96 percent of the total quantity produced at coke plants was refined by the operators. Production of benzol (all grades), the principal constituent of light oil, decreased 12 percent from 1945 and was 17 percent below the record attained in 1944. The market for refined or pure benzol was extremely active throughout the year, and more than 77 percent of the total benzol output was "nitration"—or 1°—and "industrial pure"—or 2°—grades. The production of toluol declined sharply, with a drop of 39 percent. The

diminished demand for this chemical for explosives and the release of more than 17,000,000 gallons of the Government's surplus stock were contributing factors in reducing production. The average unit value of toluol at producers' plants dropped from $0.263 per gallon in 1945 to $0.205 in 1946, indicating a depressed market. Although production of xylol and solvent naphtha decreased 20 and 8 percent, respectively, from 1945, there was an active demand for these aromatic solvents throughout the year. Prices for both xylol and solvent naphtha did not change from the 1945 pattern. However, the decline in toluol prices was responsible for the decrease from $0.503 to $0.467 in the value of crude light oil and derivatives per ton of coke produced.

TABLE 47.—Coal-chemical materials obtained from coke-oven operations in the United States in 1946 [1]

[Exclusive of screenings or breeze]

Product	Production	Sales			On hand December 31
		Quantity	Value		
			Total	Average	
Tar—gallons	596,868,745	377,998,582	$21,284,137	$0.056	26,728,081
Tar derivatives:					
Creosote oil, distillate as such—do	20,785,839	20,474,218	2,532,895	.124	671,582
Creosote oil, in coal-tar solution—do	10,336,986	9,063,960	1,224,454	.135	485,317
Tar acid oil—do	12,953,198	13,270,360	1,612,971	.122	410,316
Pitch of tar:					
Soft [2]—net tons	303,087	131	1,686	12.870	10,316
Hard [3]—do	207,403	176	1,489	8.460	370
Other tar derivatives [4]	(5)	(5)	1,570,722	(5)	(5)
Ammonia:					
Sulphate—pounds	1,287,504,417	1,284,471,366	18,024,763	.014	66,822,811
Liquor (NH_3 content)—do	49,982,452	47,042,597	1,417,296	.030	1,289,128
			19,442,059		
Sulfate equivalent of all forms—do	1,487,434,225	1,472,641,754			71,979,323
NH_3 equivalent of all forms—do	371,858,556	368,160,439			17,994,831
Gas:					
Used under boilers, etc.—M cubic feet	783,637,016 [6]	29,473,813	3,307,201	.112	
Used in steel or affiliated plants—do		265,545,711	31,172,118	.117	
Distributed through city mains—do		157,234,511	44,928,697	.285	
Sold for industrial use—do		28,235,551	3,776,663	.134	
	783,637,016 [6]	480,489,586	83,184,679	.173	
Crude light oil—gallons	206,914,333 [7]	13,199,230	1,057,863	.080	3,784,767
Light-oil derivatives:					
Benzol:					
Motor—do	27,398,866	29,146,443	2,553,191	.088	758,239
All other grades—do	109,728,963	110,378,789	14,217,634	.129	4,859,463
Toluol, crude and refined—do	16,519,763	16,186,385	3,313,317	.205	2,276,295
Xylol, crude and refined—do	5,986,250	5,869,310	1,330,568	.227	503,463
Solvent naphtha—do	4,401,158	4,105,059	529,644	.129	446,589
Other light-oil products—do	7,572,226	5,911,018	579,256	.098	462,152
	171,607,226	171,597,004	22,523,610	.131	
Naphthalene, crude—pounds	71,605,138	71,769,750	1,602,739	.022	2,347,217
Pyridine:					
Crude—gallons	329,661	362,928	241,858	.666	69,723
Refined—do	95,343	107,857	357,083	3.311	1,931
Sodium phenolate—do	2,448,547	2,385,342	150,321	.063	164,179
Other coal-chemical materials [8]	(5)	(5)	601,309	(5)	(5)
Value of all coal-chemical materials sold			[9] 157,389,875		

[1] Includes products of tar distillation conducted by coke-oven operators under same corporate name.
[2] Softening point less than 110° F.
[3] Softening point over 160° F. Includes some medium pitch of tar reported by one producer.
[4] Cresylic acid, cresols, crude anthracene, phenol, pitch coke, and road tar.
[5] Data withheld from publication to avoid disclosure of individual operations.
[6] Includes gas used for heating ovens and gas wasted.
[7] Refined on premises to make derived products shown: 198,593,963 gallons.
[8] Ammonium thiocyanate, cyanogen sludge, dicyclopentadiene, secondary oil, sodium prussiate, sulfur, and vented vapors.
[9] Exclusive of value of breeze production which was $11,717,566 in 1946.

TABLE 48.—Coal equivalent of coal-chemical materials produced at oven-coke plants in the United States, 1913, 1914, 1918, 1937, and 1944–46

Year	Quantity of coal-chemical materials				Estimated equivalent in heating value (billion B. t. u.)					Coal equivalent	
	Coke breeze (thousand net tons)	Surplus gas (billion cubic feet)	Tar produced (thousand gallons)	Light oil produced (thousand gallons)	Coke breeze	Surplus gas	Tar	Light oil	Total	Net tons	Percent this forms of coal made into coke
1913	735	64	115,145	3,000	14,700	35,200	17,272	390	67,562	2,600,000	3.8
1914	667	61	109,901	8,464	13,340	33,550	16,485	1,100	64,475	2,461,000	4.8
1918	1,999	158	263,299	87,562	39,980	86,900	39,495	11,383	177,758	6,785,000	8.0
1937	3,884	463	603,053	187,054	77,680	254,650	90,458	24,317	447,105	17,065,000	22.9
1944	4,965	621	767,807	267,862	99,300	341,550	115,171	34,822	590,843	22,551,000	21.4
1945	4,629	554	696,307	245,687	92,580	304,700	104,446	31,939	533,665	20,369,000	21.3
1946	4,232	480	596,869	206,914	84,640	264,000	89,530	26,899	465,069	17,751,000	21.3

TABLE 49.—Value of coal-chemical materials and of coke, including breeze, per ton of coke produced in the United States, 1937 and 1943–46

Product	1937	1943	1944	1945	1946
Ammonia and its compounds	$0.326	$0.355	$0.324	$0.356	$0.361
Light oil and its derivatives (including naphthalene)	.435	.546	.552	.503	.467
Surplus gas sold or used	1.483	1.390	1.403	1.413	1.542
Tar sold	.375	.385	.327	.352	.395
Miscellaneous products	.066	.178	.167	.148	.154
	2.685	2.854	2.773	2.772	2.919
Tar used, not sold	.127	.078	.131	.095	.071
Breeze produced	.162	.191	.198	.202	.217
	2.974	3.123	3.102	3.069	3.207
Value of coke produced	5.026	6.654	7.140	7.572	8.345
Total value of coke and coal-chemical materials	8.000	9.777	10.242	10.641	11.552

COKE-OVEN GAS

TABLE 50.—Coke-oven gas produced and sold in the United States in 1946, by States, in thousands of cubic feet

State	Active plants	Produced	Used in heating ovens	Surplus sold or used			Wasted
				Quantity	Value		
					Total	Average	
Alabama	7	66,563,169	30,767,881	34,722,316	$3,139,918	$0.090	1,072,972
California	1	4,694,932	362,673	4,184,033	(1)	(1)	148,226
Colorado	1	9,388,804	5,038,573	4,288,976	(1)	(1)	61,255
Illinois	9	45,245,753	13,652,805	31,061,874	4,523,559	.146	531,074
Indiana	5	90,463,761	40,266,802	48,164,698	9,741,162	.202	2,032,261
Maryland	1	23,183,811	7,984,638	14,316,721	(1)	(1)	882,452
Massachusetts	2	15,523,828	2,344,673	13,132,080	(1)	(1)	47,075
Michigan	4	34,134,378	6,046,842	27,928,019	4,199,967	.150	159,517
Minnesota	3	12,561,845	5,273,855	7,209,709	1,930,858	.268	78,281
New Jersey	2	18,663,973	5,109,529	13,554,444	(1)	(1)	----------
New York	8	75,942,644	20,614,721	54,932,115	16,645,799	.303	395,808
Ohio	15	118,128,622	54,769,238	61,933,555	8,355,447	.135	1,425,829
Pennsylvania	13	192,168,936	82,176,034	109,134,530	14,163,789	.130	858,372
Tennessee	1	2,958,764	1,287,670	1,649,019	(1)	(1)	22,075
Utah	2	9,713,238	2,234,839	7,210,010	(1)	(1)	268,389
West Virginia	5	34,070,755	10,682,607	22,360,810	2,084,721	.093	1,027,338
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	6	30,229,803	5,072,145	24,706,677	6,325,999	.256	450,981
Undistributed	----------	----------	----------	----------	12,073,460	.207	----------
Total 1946	85	783,637,016	293,685,525	480,489,586	83,184,679	.173	9,461,905
At merchant plants	32	178,572,615	40,135,615	136,354,903	39,149,451	.287	2,082,097
At furnace plants	53	605,064,401	253,549,910	344,134,683	44,035,228	.128	7,379,808
Total 1945	87	904,476,118	337,128,344	554,253,412	87,745,022	.158	13,094,362

[1] Included under "Undistributed."

TABLE 51.—Coke-oven gas and other kinds of gas used in heating ovens in 1946, by States, in thousands of cubic feet [1]

State	Coke-oven gas	Producer gas	Blue water gas	Blast furnace gas	Other gases	Total coke-oven gas equivalent
Alabama	30,767,881	----------	----------	----------	[2] 250,223	31,018,104
California	362,673	----------	----------	1,567,120	----------	1,929,793
Colorado	5,038,573	----------	----------	----------	----------	5,038,573
Illinois	13,652,805	638,582	----------	4,278,125	[3] 2,665,951	21,235,463
Indiana	40,266,802	711,645	748,521	----------	[3] 1,178,067	42,905,035
Maryland	7,984,638	----------	----------	11,025,000	----------	19,009,638
Massachusetts	2,344,673	4,256,476	----------	----------	----------	6,601,149
Michigan	6,046,842	----------	----------	4,944,660	----------	10,991,502
Minnesota	5,273,855	150,445	7,702	----------	[4] 188,521	5,620,523
New Jersey	5,109,529	2,447,627	----------	----------	----------	7,557,156
New York	20,614,721	10,820,350	1,022,968	406,397	[5] 66,826	32,931,262
Ohio	54,769,238	----------	----------	2,124,816	----------	56,894,054
Pennsylvania	82,176,034	1,563,257	65,476	1,369,395	[6] 2,212,978	87,387,140
Tennessee	1,287,670	----------	----------	----------	----------	1,287,670
Utah	2,234,839	----------	----------	2,041,533	----------	4,276,372
West Virginia	10,682,607	----------	----------	1,898,256	[7] 1,766,000	14,346,863
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	5,072,145	5,828,339	----------	----------	[2] 1,920,432	12,820,916
	293,685,525	26,416,721	1,844,667	29,655,302	10,248,998	361,851,213
At merchant plants	40,135,615	26,180,311	1,771,489	----------	7,553,401	75,640,816
At furnace plants	253,549,910	236,410	73,178	29,655,302	2,695,597	286,210,397

[1] Corrected to 550 B. t. u. per cubic foot.
[2] Natural gas.
[3] Natural and petroleum gas.
[4] Butane air gas.
[5] Petroleum gas.
[6] Natural and oil gas.
[7] Spillage gas.

TABLE 52.—Disposal of surplus coke-oven gas in the United States in 1946, by States, in thousands of cubic feet

State	Used by producer—						Sold					
	Under boilers			In steel or other affiliated plant			Distributed through city mains			For industrial purposes		
	Quantity	Value		Quantity	Value		Quantity	Value		Quantity	Value	
		Total	Average		Total	Average		Total	Average		Total	Average
Alabama	5,147,816	$291,252	$0.057	21,156,373	$1,955,887	$0.092	7,256,491	$780,781	$0.108	1,161,636	$111,998	$0.096
California				4,184,033	(1)	(1)						
Colorado				4,288,976	(1)	(1)						
Illinois	4,731,035	476,692	.101	6,010,401	981,924	.163	19,901,882	3,014,656	.151	418,556	50,287	.120
Indiana	2,867,765	(1)	(1)	35,457,222	4,777,800	.135	8,116,516	4,027,399	.496	1,723,195	(1)	(1)
Maryland				8,685,270	(1)	(1)	5,631,451	(1)	(1)			
Massachusetts	3,619	(1)	(1)				13,022,482	(1)	(1)	105,979	(1)	(1)
Michigan	3,538,042	(1)	(1)	22,510,074	3,368,265	.150				1,879,903	(1)	(1)
Minnesota	224,755	12,253	.055	2,032,566	(1)	(1)	4,952,388	(1)	(1)			
New Jersey				18,243	(1)	(1)	13,536,201	(1)	(1)			
New York	1,537,565	154,886	.101	12,953,176	(1)	(1)	38,852,239	14,521,570	.374	1,589,135	(1)	(1)
Ohio	3,170,562	478,054	.151	43,315,118	5,617,259	.130	5,283,291	1,113,501	.211	10,164,584	1,146,633	.113
Pennsylvania	3,927,295	(1)	(1)	80,758,306	8,069,595	.100	18,044,261	4,779,228	.265	6,404,668	(1)	(1)
Tennessee	273,091	(1)	(1)				1,375,928	(1)	(1)			
Utah	1,735,577	(1)	(1)	4,613,423	(1)	(1)	708,174	(1)	(1)	152,836	(1)	(1)
West Virginia	1,138,068	(1)	(1)	19,562,530	1,791,543	.092				1,660,212	(1)	(1)
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	1,178,623	176,672	.150				20,553,207	5,929,952	.289	2,974,847	219,375	.074
Undistributed		1,717,392	.127		4,609,845	.125		10,761,610	.274		2,248,370	.166
Total 1946	29,473,813	3,307,201	.112	265,545,711	31,172,118	.117	157,234,511	44,928,697	.286	28,235,551	3,776,663	.134
At merchant plants	6,750,703	747,900	.111	6,609,132	842,374	.127	107,982,090	35,555,286	.329	15,012,978	2,003,891	.133
At furnace plants	22,723,110	2,559,301	.113	258,936,579	30,329,744	.117	49,252,421	9,373,411	.190	13,222,573	1,772,772	.134
Total 1945	32,061,903	3,098,350	.097	324,294,221	36,972,600	.114	166,178,375	43,532,085	.262	31,718,913	4,141,987	.131

[1] Included under "Undistributed."

TAR

TABLE 53.—Coke-oven tar produced, used by producer, and sold in the United States in 1946, by States, in gallons

State	Produced		Used by producer—				Sold—					On hand Dec. 31
									Total			
	Total	Per ton of coal coked	For refining or topping	As fuel under boilers	In open-hearth or affiliated plants	Otherwise	For use as fuel [1]	For refining into tar products	Quantity	Value		
										Total	Average	
Alabama	52,021,128	7.97		305,724	18,606,374	98,657		32,517,021	32,517,021	$1,902,155	$0.058	2,567,787
California	4,257,739	10.13	4,309,574			45,250						115,663
Colorado	8,556,000	10.28	8,321,441					80,277	80,277	(2)	(2)	336,238
Illinois	30,225,340	6.71		302,704			3,627,774	26,977,917	30,605,691	1,645,810	.054	1,056,934
Indiana	54,613,734	5.94	14,341,245		257,162	1,730,304	1,920,341	36,700,969	38,621,310	2,177,954	.056	3,414,858
Maryland	16,940,865	7.38			225,362			16,973,029	16,973,029	(2)	(2)	1,441,020
Massachusetts	11,307,012	7.55						11,296,842	11,296,842	(2)	(2)	91,478
Michigan	24,995,010	7.20				468		25,813,420	25,813,420	1,393,926	.054	525,888
Minnesota	7,559,421	6.34			1,900,516	4,000		5,565,550	5,565,550	324,111	.058	753,912
New Jersey	12,902,794	7.42						12,807,794	12,807,794	(2)	(2)	607,000
New York	57,522,999	8.09	13,769,623			37,923	474,729	44,135,246	44,609,975	2,546,732	.057	2,169,165
Ohio	82,326,943	6.90	1,492,142	447,041	9,108,746	537,558	4,640,775	66,817,681	71,458,456	4,171,381	.058	3,488,593
Pennsylvania	169,296,640	9.10	112,827,196		31,278,693	324,234	298,174	26,272,284	26,570,458	1,480,456	.056	7,586,352
Tennessee	2,373,277	7.55						2,369,440	2,369,440	(2)	(2)	21,261
Utah	9,171,343	11.36			3,320,877	1,066	5	6,089,712	6,089,717	(2)	(2)	1,047,085
West Virginia	32,264,045	10.50				636		32,190,049	32,190,049	1,874,241	.058	580,265
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	20,534,455	7.21				550		20,429,553	20,429,553	1,095,947	.053	924,582
Undistributed										2,671,424	.054	
Total 1946	596,868,745	7.82	155,061,221	1,055,469	64,697,730	2,780,646	10,961,798	367,036,784	377,998,582	21,284,137	.056	26,728,081
At merchant plants	132,678,443	7.72	393,019			20,473		132,605,390	132,605,390	7,154,564	.054	4,153,576
At furnace plants	464,190,302	7.85	154,668,202	1,055,469	64,697,730	2,760,173	10,961,798	234,431,394	245,393,192	14,129,573	.058	22,574,505
Total 1945	696,307,311	7.95	178,575,329	575,121	107,218,838	3,633,314	26,628,037	383,871,287	410,499,324	21,827,890	.053	30,859,495

[1] Comprises 558,601 gallons sold to affiliated plants and 10,403,197 gallons to other purchasers.
[2] Included under "Undistributed."

AMMONIA

TABLE 54.—Coke-oven ammonia produced and sold in the United States in 1946, by States, in pounds

State	Active plants	Sulfate equivalent of all forms		Produced as—		Sold as—				On hand Dec. 31	
		Quantity	Per ton of coal coked	Sulfate	Liquor (NH_3 content)	Sulfate		Liquor (NH_3 content)		Sulfate	Liquor (NH_3 content)
						Quantity	Value	Quantity	Value		
Alabama	7	148,228,385	22.70	135,458,585	3,192,450	136,731,313	$1,967,661	3,204,660	(1)	2,593,614	91,311
California	1	11,016,772	26.21	11,016,772		10,901,840	(1)			213,965	
Colorado	1	17,828,016	21.42	17,828,016		15,874,655	(1)			2,804,361	
Illinois	8	79,057,011	19.34	79,057,011		79,585,026	1,104,543			3,178,259	
Indiana	5	159,118,289	17.30	134,590,301	6,131,997	135,239,640	1,801,507	6,268,656	$162,878	9,770,230	151,111
Maryland	1	45,883,476	19.98	45,883,476		45,377,830	(1)			2,003,817	
Massachusetts	2	25,994,460	17.36	25,447,420	136,760	25,692,500	(1)	130,890	(1)	591,180	15,790
Michigan	4	72,991,585	21.03	26,154,117	11,709,367	25,130,520	(1)	9,977,877	(1)	1,524,400	292,796
Minnesota	3	19,949,960	16.73	19,949,960		19,076,550	263,031			2,602,232	
New Jersey	2	31,490,470	18.11	31,490,470		30,974,970	(1)			902,240	
New York	8	137,160,855	19.29	107,969,279	7,297,894	107,454,587	1,555,231	7,011,141	220,648	3,296,363	170,532
Ohio	15	220,200,023	18.47	173,001,959	11,799,516	176,017,992	2,397,920	10,557,872	329,420	4,020,064	330,410
Pennsylvania	13	386,033,241	20.76	384,001,101	508,035	382,093,356	5,121,274	510,621	(1)	28,694,549	34,102
Tennessee	1	6,867,919	21.85	6,867,919		7,016,240	(1)			127,872	
Utah	2	20,262,208	25.09	20,262,208		19,649,742	(1)			1,281,004	
West Virginia	3	51,009,203	21.72	51,009,203		49,392,955	670,988			2,156,103	
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	5	54,342,352	19.35	17,516,620	9,206,433	18,261,650	256,878	9,380,880	270,549	1,062,558	203,076
Undistributed							2,885,730		433,801		
Total 1946	81	1,487,434,225	19.79	1,287,504,417	49,982,452	1,284,471,366	18,024,763	47,042,597	1,417,296	66,822,811	1,289,128
At merchant plants	30	328,752,993	19.73	197,708,265	32,761,182	198,882,138	2,858,884	35,488,882	1,062,718	6,034,154	964,422
At furnace plants	51	1,158,681,232	19.80	1,089,796,152	17,221,270	1,085,589,228	15,165,879	11,553,715	354,578	60,788,657	324,706
Total 1945	84	1,749,437,753	20.22	1,528,585,257	55,213,124	1,602,123,800	20,534,078	51,439,125	1,556,101	64,350,762	1,907,665

[1] Included under "Undistributed."

CRUDE LIGHT OIL AND ITS DERIVATIVES

TABLE 55.—Coke-oven crude light oil produced in the United States and derived products obtained and sold in 1946, by States, in gallons

State	Active plants	Produced		Refined on premises [1]	Derived products			On hand Dec. 31
		Total	Per ton of coal coked		Produced	Sold [2]		
						Quantity	Value	
Alabama	7	18,086,578	2.77	17,509,374	15,122,047	14,941,494	$1,905,480	211,387
California	1	1,483,771	3.53	1,480,574	1,282,293	1,144,339	[3]	14,573
Colorado	1	2,600,241	3.12	2,548,586	2,525,198	2,430,857	[3]	52,100
Illinois	7	11,349,152	2.64	8,296,664	6,914,688	6,894,296	927,429	222,802
Indiana	5	20,733,734	2.25	21,672,237	19,215,736	18,965,902	2,502,036	404,588
Maryland	1	8,874,938	3.87	8,867,604	7,315,417	8,035,446	[3]	83,692
Michigan	4	9,526,543	2.74	4,774,012	4,064,966	4,138,640	[3]	129,200
New York	8	18,179,147	2.56	29,225,386	25,113,832	25,831,367	3,617,312	284,027
Ohio	15	32,749,525	2.75	28,717,034	22,967,259	23,232,691	2,910,435	476,213
Pennsylvania	13	56,221,356	3.02	54,724,800	48,262,929	48,808,712	6,076,987	1,433,860
Tennessee	1	773,984	2.46	773,984	711,357	763,020	[3]	7,066
Utah	2	3,456,224	4.28	3,429,540	2,839,386	2,640,435	[3]	57,362
West Virginia	5	10,681,587	3.48	9,802,204	8,640,394	7,249,981	1,071,570	109,184
Connecticut, Kentucky, Massachusetts, Missouri, New Jersey, and Wisconsin	7	12,197,553	2.14	6,771,964	6,631,724	6,519,824	928,002	298,713
Undistributed	------	----------	------	----------	----------	----------	2,584,359	---------
Total 1946	77	206,914,333	2.77	198,593,963	171,607,226	171,597,004	22,523,610	3,784,767
At merchant plants	26	35,750,205	2.21	34,850,081	31,374,571	30,371,053	4,194,408	980,008
At furnace plants	51	171,164,128	2.93	163,743,882	140,232,655	141,225,951	18,329,202	2,804,759
Total 1945	80	245,687,253	2.84	234,802,231	202,669,566	191,275,133	27,887,495	4,187,551

[1] Comprises 191,656,098 gallons of crude light oil from own production and 6,937,865 gallons purchased from other coke-oven plants.
[2] Excludes 13,199,230 gallons of crude light oil valued at $1,057,863 sold as such.
[3] Included under "Undistributed."

NAPHTHALENE

TABLE 56.—Crude naphthalene produced and sold by coke-plant operators in the United States, 1942–46

Year	Produced (pounds)	Sold			Receipts per ton of coke
		Pounds	Value		
			Total	Average per pound	
1942	95,612,788	95,039,639	$1,941,626	$0.020	$0.031
1943	98,096,899	98,031,058	2,088,829	.021	.033
1944	103,041,023	103,839,789	2,094,596	.020	.031
1945	87,677,299	86,936,517	1,806,967	.021	.029
1946	71,605,138	71,769,750	1,602,739	.022	.030

VERTICAL SLOT-TYPE COKE OVENS OWNED BY CITY GAS COMPANIES (PUBLIC UTILITIES)

The accompanying table compares statistics on the operations of coke plants operated by gas utilities with those plants not owned by city gas companies for 1945 and 1946. This classification is maintained by the Bureau of Mines in the interest of those who may want to obtain information on the coking operations of city gas works proper and also to show their relative value to the coke industry as a whole.

Oven-coke plants owned by city gas companies contributed 6 percent of the total production of oven coke in 1946, 7 percent of the gas, 7 percent of the tar, 3 percent of the light oil, and 5 percent of the ammonia. The number of operations in this group has been declining during the past 10 years because of the substitution of natural gas for coke-oven gas in certain areas; consequently, the number of active plants dropped from 21 in 1936 to 14 in 1946. Normally, maximum production of gas of proper analysis is the primary objective of these plants; however, the increased demand for industrial coke caused many operators to place more emphasis on coke, and in 1946 more than one-fifth of the foundry-coke requirements and a quarter of a million tons of blast-furnace coke came from this group of plants.

TABLE 57.—Production of coke, breeze, and coal-chemical materials in the United States at oven-coke plants owned by city gas companies (public utilities [1]) and at all other oven-coke plants, 1945–46

Product	1945			1946		
	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities)	Total	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities)	Total
Number of active plants	72	15	87	71	14	85
Coke:						
Production—net tons	58, 430, 076	3, 664, 212	62, 094, 288	50, 459, 266	3, 470, 181	53, 929, 447
Value	$437, 080, 202	$33, 110, 137	$470, 190, 339	$416, 145, 126	$33, 915, 086	$450, 060, 212
Average per ton	$7. 48	$9. 04	$7. 57	$8. 25	$9. 77	$8. 35
Screenings or breeze:						
Production—net tons	4, 277, 316	351, 217	4, 628, 533	3, 918, 828	313, 424	4, 232, 252
Sales—do	1, 061, 082	27, 808	1, 088, 890	987, 728	35, 859	1, 023, 587
Value of sales	$2, 908. 281	$90. 145	$2, 998. 426	$2, 932. 544	$116. 540	$3, 049, 084
Average per ton	$2. 74	$3. 24	$2. 75	$2. 97	$3. 25	$2. 98
Coal charged into ovens:						
Bituminous—net tons	82, 069, 793	5, 144, 370	87, 214, 163	71, 299, 287	4, 821, 387	76, 120, 674
Anthracite—do	285, 686	36, 915	322, 601	193, 272	45, 540	238, 812
Total—do	82, 355, 479	5, 181, 285	87, 536, 764	71, 492, 559	4, 866, 927	76, 359, 486
Value	$429, 455, 738	$33, 039, 337	$462, 495, 075	$406, 831, 627	$33, 711, 873	$440, 543, 500
Average per ton	$5. 21	$6. 38	$5. 28	$5. 69	$6. 93	$5. 77
Coke—						
Used by producer:						
Net tons	35, 840, 503	1, 329, 067	37, 169, 570	30, 937, 637	1, 419, 693	32, 357, 330
Value	$266, 844, 670	$9, 454, 255	$276, 298, 925	$251, 916, 628	$10, 813, 296	$262, 729, 924
Sold:						
Net tons	22, 557, 426	2, 379, 182	24, 936, 608	19, 416, 705	2, 076, 201	21, 492, 906
Value	$169, 949, 107	$24, 066, 683	$194, 015, 790	$163, 385, 251	$23, 381, 344	$186, 766, 595
Coal-chemical materials:						
Tar:						
Production—gallons	652, 106, 266	44, 201, 045	696, 307, 311	556, 733, 395	40, 135, 350	576, 868, 745
Sales—do	366, 043, 225	44, 456, 099	410, 499, 324	337, 629, 254	40, 369, 328	377, 998, 582
Value of sales	$19, 476, 954	$2, 350, 936	$21, 827, 890	$19, 037, 987	$2, 246, 150	$21, 284, 137

See footnote at end of table.

TABLE 57.—Production of coke, breeze, and coal-chemical materials in the United States at oven-coke plants owned by city gas companies (public utilities [1]) and at all other oven-coke plants, 1945–46—Continued

Product	1945			1946		
	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities)	Total	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities)	Total
Coal-chemical materials—Continued.						
Ammonia:						
Production (NH_3 equivalent of all forms) pounds	414,637,421	22,722,017	437,359,438	351,563,681	20,294,875	371,858,556
Liquor (NH_3 content):						
Production—pounds	50,801,127	4,411,997	55,213,124	46,549,806	3,432,646	49,982,452
Sales—do	47,054,833	4,384,292	51,439,125	43,654,464	3,388,133	47,042,597
Value of sales	$1,453,291	$102,810	$1,556,101	$1,338,110	$79,186	$1,417,296
Sulfate:						
Production—pounds	1,455,345,178	73,240,079	1,528,585,257	1,220,055,501	67,448,916	1,287,504,417
Sales—do	1,526,866,800	75,257,000	1,602,123,800	1,216,239,403	68,231,963	1,284,471,366
Value of sales	$19,491,616	$1,042,462	$20,534,078	$17,052,633	$972,130	$18,024,763
Gas:						
Production, M cubic feet	847,848,089	56,628,029	904,476,118	729,866,510	53,770,506	783,637,016
Disposal of surplus:						
Used under boilers:						
M cubic feet	32,017,600	44,303	32,061,903	29,440,189	33,624	29,473,813
Value	$3,092,247	$6,103	$3,098,350	$3,301,804	$5,397	$3,307,201
Average per M cubic feet	$0.097	$0.138	$0.097	$0.112	$0.161	$0.112
Used in steel or affiliated plants:						
M cubic feet	324,241,986	52,235	324,294,221	265,545,711	----------	265,545,711
Value	$36,952,380	$20,220	$36,972,600	$31,172,118	----------	$31,172,118
Average per M cubic feet	$0.114	$0.387	$0.114	$0.117	----------	$0.117
Distributed through city mains:						
M cubic feet	114,960,029	51,218,346	166,178,375	109,804,033	47,430,478	157,234,511
Value	$26,110,110	$17,421,975	$43,532,085	$26,823,495	$18,105,202	$44,928,697
Average per M cubic feet	$0.227	$0.340	$0.262	$0.244	$0.382	$0.285
Sold for industrial use:						
M cubic feet	29,102,560	2,616,353	31,718,913	26,055,615	2,179,936	28,235,551
Value	$3,236,809	$905,178	$4,141,987	$3,028,974	$747,689	$3,776,663
Average per M cubic feet	$0.111	$0.346	$0.131	$0.116	$0.343	$0.134
Crude light oil:						
Production—gallons	237,439,484	8,247,769	245,687,253	199,969,160	6,945,173	206,914,333
Sales—do	13,822,795	4,296,117	18,118,822	9,360,362	3,838,868	13,199,230
Value of sales	$1,230,003	$331,234	$1,561,237	$789,368	$268,495	$1,057,863
Light oil derivatives:						
Production—gallons	198,864,848	3,804,718	202,669,566	168,651,584	2,955,642	171,607,226
Sales—do	187,587,304	3,687,829	191,275,133	168,452,382	3,144,622	171,597,004
Value of sales	$27,468,672	$418,823	$27,887,495	$22,172,659	$350,951	$22,523,610
Naphthalene, crude:						
Production—pounds	86,898,339	778,960	87,677,299	71,014,970	590,168	71,605,138
Sales—do	86,157,557	778,960	86,936,517	71,179,582	590,168	71,769,750
Value of sales	$1,791,522	$15,445	$1,806,967	$1,591,061	$11,678	$1,602,739
All other coal-chemical materials, value	$9,159,124	$60,291	$9,219,415	$8,207,451	$87,337	$8,294,788

[1] Vertical slot-type ovens built by city gas companies, some of which are operated in conjunction with coal-, oil-, and water-gas plants. Does not include independent oven-coke plants which may sell gas to public-utility companies for distribution.

Copper

By CHARLES WHITE MERRILL AND HELENA M. MEYER

	PAGE
General summary	457
Salient statistics	459
Government regulations	461
Domestic production	462
Primary copper	462
Mine production	462
Quantity and estimated recoverable content of copper-bearing ores	466
Smelter production	468
Domestic production—Continued	
Primary copper—Continued	
Refinery production	468
Copper sulfate	470
Secondary copper	470
Consumption	470
Stocks	472
Prices	473
Foreign trade	475
World review	479

GENERAL SUMMARY

THE DOMESTIC copper industry in 1946 was featured by a reconversion demand exceeding most estimates made during 1945 and by mine production far below capacity. During 1944 and 1945 grave concern was expressed by well-informed observers that, with the termination of hostilities, war stocks augmented by a flood of copper from war-stimulated mines throughout the world would engulf the domestic mining industry and result in stagnation such as followed World War I. Through 1946, however, no evidence appeared of a satiation of demand to fulfill postponed need and to restock inventories in the peacetime channels of trade. Not only did demand exceed the expectations of many, but the supply from domestic sources fell far short of capacity, largely as a result of a difficult labor situation. Labor forces that had deteriorated during the war were not rebuilt promptly with the release of war-industry workers and the demobilization of the armed forces. Apparently copper mining was relatively unattractive compared with other kinds of available employment. In addition, a number of management-labor negotiations under way in the copper industry late in 1945 failed to produce acceptable working contracts, and very serious strikes in mines, smelters, refineries and fabricating plants were called. For example, at the Utah Copper mine—the largest copper producer in the United States—a strike caused a complete shut-down from January 21 to June 24. By midyear, however, the major strikes had been settled, and copper production rose sharply during the rest of the year; 61 percent of the year's output was credited to the last 6 months.

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Drilling at the San Manuel property near Tiger, Ariz., had developed enough ore by the end of 1946 to prove that a major copper ore body had been discovered. Thus, for the first time in a generation, a substantial addition had been made to United States copper reserves from a recently discovered ore body. According to the annual report to stockholders of the Magma Copper Co., which is developing the San Manuel Copper Corp. ore body, 211,500,000 tons of ore, averaging 0.77 percent copper, had been calculated as estimated reserves by December 31, 1946. This was classified as 66,600,000 tons of 0.70-percent oxide ore, 45,300,000 tons of 0.88-percent mixed oxide and sulfide ore, and 99,600,000 tons of 0.75-percent sulfide ore.

In 1946, as in 1945, domestic mines did not supply much more copper than did old scrap. Of the 1946 total from these two sources, 59 percent was new copper from mines and 41 percent secondary metal from old scrap. In addition, 397,093 tons of copper were recovered from new scrap in 1946.

A consumption record for peacetime years was established in 1946. The quantities of virgin copper and of all copper exceeded the earlier peace-year highs of 1940 and 1929 by wide margins. Even the war-year highs for 1941–45 had not absorbed copper in quantities very greatly in excess of this first full year of peace; the new refined copper withdrawn for domestic account in 1946 was only 15 percent less than the all-time high established in 1941. The tremendous demand for copper combined with reduced production, because of strikes and other factors, resulted in heavy withdrawals from stocks. At the beginning of 1946, nearly 600,000 tons of refined and unrefined copper were available for allocation by the Office of Metals Reserve, but by the end of the year this supply had been reduced to less than 100,000 tons. The projected accumulation of a strategic stock pile of copper under the Strategic and Critical Materials Stock-Piling Act, approved by the President July 23, 1946, made virtually no progress during the year because of a provision that industrial reconversion must not be retarded by withdrawal of supplies to stock piles. In approving the bill the President stated his reluctance because of the bill's reaffirmation of the application to stock-pile purchase of the provisions of the "buy American" act of 1933. He pointed out, however, that "the Act also provides that exceptions to this rule may be made when 'buy American' purchases are determined to be inconsistent with the public interest or the cost to be unreasonable, and that this provision clearly indicated that the stock-piling program should not be used as a means of generally subsidizing those domestic producers who otherwise could not compete successfully with other domestic or foreign producers."

During 1946 a free domestic copper market was reestablished after over 5 years during which the Office of Price Administration had controlled the situation with price ceilings. From a ceiling price of 12 cents a pound in effect at the beginning of the year, the free market price at year end had risen to 19½ cents, the highest since April 1929. The upward movement continued into 1947. Late in 1946 the price of copper exceeded that for aluminum for the first time in history, with the result that serious concern was expressed about the possibil-

ity of large-scale substitution of the light metal for copper in some important fields. The supplies of both metals were so short that price was not the primary factor in determining purchases, but a continuation of copper prices above those for aluminum into a period of plentiful supply would result in a considerable shift in the use patterns for both metals.

Salient statistics of the copper industry in the United States, 1942–46, in short tons

	1942	1943	1944	1945	1946
New copper produced—					
From domestic ores, as reported by—					
Mines	1,080,061	1,090,818	972,549	772,894	608,737
Ore produced:					
Copper ore [1]	92,285,626	98,119,735	91,063,648	[2]77,472,983	62,232,342
Average yield of copper, percent	1.09	1.04	.99	.93	.91
Smelters	1,087,991	1,092,939	1,003,379	782,726	599,656
Percent of world total	35	36	35	32	30
Refineries	1,064,792	1,082,079	973,852	775,738	578,429
From foreign ores, matte, etc., refinery reports	349,769	297,184	247,335	332,861	300,233
Total new refined, domestic and foreign	1,414,561	1,379,263	1,221,187	1,108,599	878,662
Secondary copper recovered from old scrap only	427,122	427,521	456,710	[2] 497,095	406,453
Copper content of copper sulfate produced by refiners	8,076	7,667	8,269	8,237	5,070
Total production, new and old and domestic and foreign	1,849,759	1,814,451	1,686,166	[2] 1,613,931	1,290,185
Imports (unmanufactured) [3]	764,393	716,596	785,211	853,196	393,275
Refined [3]	401,436	402,762	492,395	531,367	154,371
Exports of metallic copper [4]	210,518	294,459	237,515	132,545	97,475
Refined (ingots, bars, rods, etc.)	131,732	177,341	69,002	53,572	[5] 52,629
Stocks at end of year	319,500	309,500	392,000	461,000	350,000
Refined copper	84,000	68,500	81,000	130,000	96,000
Blister and materials in solution	235,500	241,000	311,000	331,000	254,000
Withdrawals from total supply on domestic account:					
Total new copper	[2] 1,608,000	[2] 1,502,000	[2] 1,504,000	[2] 1,415,000	1,391,000
Total new and old copper	[2] 2,536,000	[2] 2,588,000	[2] 2,455,000	[2] 2,422,000	2,195,000
Price, average [6] ..... cents per pound	11.8	11.8	11.8	11.8	14.4
World smelter production, new copper	3,076,000	3,038,000	2,843,000	[7] 2,425,000	[7] 2,023,000

[1] Includes old tailings.
[2] Revised figure.
[3] Data include copper imported for immediate consumption plus material entering country under bond.
[4] Total exports of copper, exclusive of ore, concentrates, composition metal, and unrefined copper. Exclusive also of "Other manufactures of copper," for which figures of quantity are not recorded.
[5] Excludes rods.
[6] Exclusive of bonus payments of the Office of Metals Reserve.
[7] Estimated.

The low rate of production by domestic copper mines was paralleled abroad, where the output of foreign mines in 1946 was at little more than two-thirds of their aggregate capacity, as measured by recent peak-year data. Chile, Northern Rhodesia, and Canada were beset by labor strikes and shortages; in Northern Rhodesia and the Belgian Congo shortage of coal, caused largely by transportation difficulties, was a principal production handicap; in Chile a light snowfall resulted in inadequate hydroelectric power; and in Canada voluntary restriction of nickel production reduced supplies of the associated copper. The rising output at domestic mines in late 1946 was not paralleled at foreign properties as a whole.

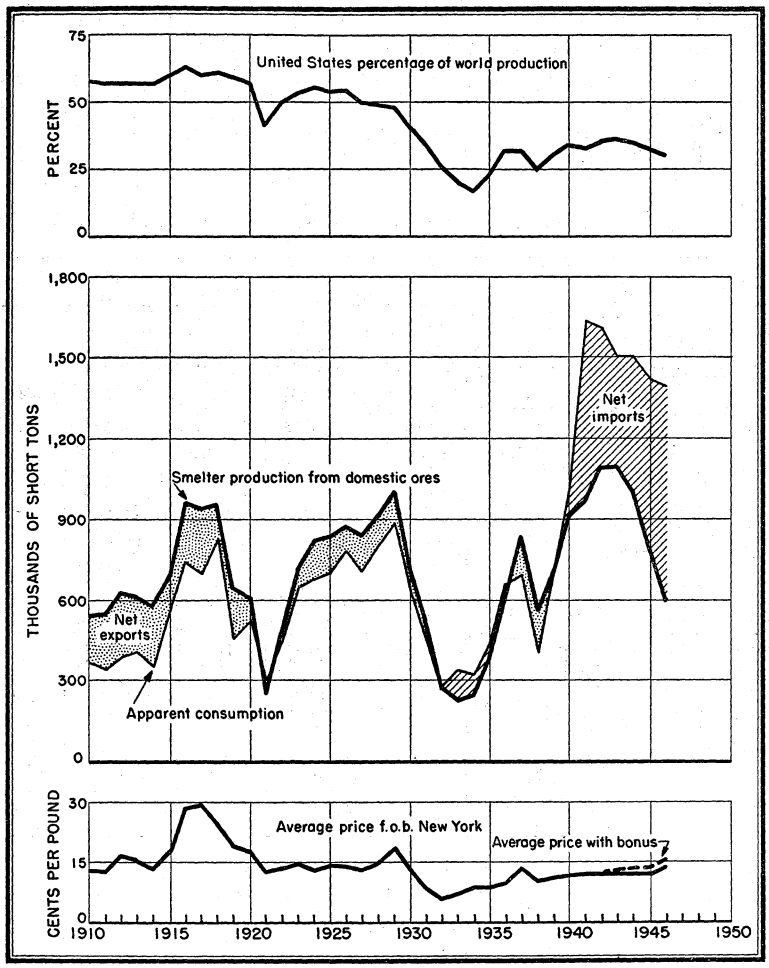

FIGURE 1.—Trends in production, consumption, and price of copper in the United States, 1910–46.

The following Reports of Investigations, published recently by the Bureau of Mines, cover properties examined almost entirely in World War II. The results of such examinations were available previously on a confidential basis only.

3873. Exploration at the Cline Mine, Cabarrus County, N. C.
3896. Exploration of the El Dorado Copper Mine, El Dorado County, Calif.
3914. Exploration of the Copper Butte Mine, Mineral Creek Mining District, Pinal County, Ariz.
3939. Exploration of the Moffet-Johnston Copper Property, Madison County, Mont.
3942. Exploration of the Copper-Sulfur Deposit, Khayyam and Stumble-On Properties, Prince of Wales Island, Alaska.

3950. Exploration of a Nickel-Copper-Cobalt Deposit at Funter Bay, Admiralty Island, Alaska.
3973. Exploration of the Queen Mary Copper Project, Missoula County, Mont.
4006. Old Reliable Copper Mine, Pinal County, Ariz.
4013. Apex Copper Property, Coconino County, Ariz.
4015. Sullivan Copper Mine, Cochise County, Ariz.
4016. Amargosa (Esperanza) Molybdenum-Copper Property, Pima County, Ariz.
4023. Zonia Copper Mine, Yavapai County, Ariz.
4026. Stauber Copper Mine, Guadalupe County, N. Mex.
4029. Atwood Copper Group, Lordsburg District, Hidalgo County, N. Mex.
4038. Bull Run Copper Prospects, Silver Bow County, Mont.
4046. Copper King Mine, Taos County, N. Mex.

Reports recently released by the Geological Survey are as follows:

Professional Paper 209. The Ajo Mining District, Arizona.
Bull. 947–E. Copper Bullion Claims, Rua Cove, Knight Island, Alaska.
Bull. 947–F. Copper Deposits of the Nizina District, Alaska.
Bull. 947–G. Copper Deposits of the Kotsina–Kushulana District, Alaska.

GOVERNMENT REGULATIONS

On January 29 the Reconstruction Finance Corporation announced that the Office of Metals Reserve was reestablishing the foreign public purchase program, discontinued in October 1945. On November 19 the purchase program was terminated again, subject to the fulfillment of commitments already made, owing to elimination of Office of Price Administration ceilings (discussed in the next paragraph).

In midyear the OPA announced the first increase in ceiling prices for copper since they were established on August 12, 1941. The price for electrolytic copper, delivered Connecticut Valley, was raised, effective June 3, to 14⅜ cents, contingent upon the completion of certain wage agreements. This action resulted in a two-price condition. Uncertainty attended the almost month-long interim (July 1–25) in the operation of OPA. The two prices were eliminated August 2, when 14⅜ cents was established for all sales. All price controls for copper were removed by the OPA order, effective November 10, that eliminated virtually all price controls. With OPA ceilings removed, RFC announced it would begin to pay as soon as practicable the 4-cent excise tax on foreign copper imported. When the ceiling price was increased, bonuses for copper under the Premium Price Plan were reduced by an identical amount, so that the Government, rather than producers under the plan, benefited. The Premium Price Plan was recessed along with OPA in July but retroactive provisions were made to bridge the gap. This plan continued on after most ceiling prices were discontinued.

Civilian Production Administration action was chiefly in the direction of channeling available copper, largely from Office of Metals Reserve inventories and copper and copperbase alloy scrap held by the Army, Navy, Maritime Commission, and War Assets Administration, to users in most critical need of the metal.

The Strategic and Critical Stock-Piling Bill, signed by the President July 24, was discussed in the opening section of this report.

DOMESTIC PRODUCTION

Statistics on copper production may be compiled upon a mine, smelter, or refinery basis. Mine data are most accurate for showing the geographic distribution of production; smelter figures are better than mine figures for showing the actual recovery of metal, and more accurate than refinery figures for showing the source of production; and refinery statistics are best for showing metal recovery, but indicate only in a general way the source of crude materials treated. The chapter on Copper in Mineral Resources of the United States, 1930, part I, discusses differences among the three sets of figures.

Copper produced from domestic ores, as reported by mines, smelters, and refineries, 1942–46, in short tons

Year	Mine	Smelter	Refinery
1942	1,080,061	1,087,991	1,064,792
1943	1,090,818	1,092,939	1,082,079
1944	972,549	1,003,379	973,852
1945	772,894	782,726	775,738
1946	608,737	599,656	578,429

PRIMARY COPPER

Mine Production.—The figures for mine production are tabulated from reports supplied by all domestic mines that produce copper. These data are classified geographically, by metallurgical methods, and by types of ore. Tables presenting the information in detail are to be found in the State chapters of this volume.

In 1946 Arizona continued to be the leading mine producer of copper, having taken the lead from Montana in 1907 and having ranked ahead of all other States thereafter, except in 1909, when Montana resumed first place for 1 year. Utah, where the largest domestic copper producer is located, continued in second place. These two States were followed in order by Montana, New Mexico, Nevada, and Michigan; there were 12 other producing States in 1946, 4 of which produced less than 10 tons each.

Accompanying tables cover mine production by States and list the leading copper-producing districts and mines.

A classification of production by mining methods shows that approximately 58 percent of the copper and 66 percent of the copper ore came from open pits in 1946. Most domestic copper ore was treated by flotation at or very near the mine of origin, and the resulting concentrates were shipped for smelting. Some copper ores were direct-smelted either because of their high grade or because of their fluxing qualities.

Mine production of recoverable copper in the United States, 1936–46, with production of maximum year, and cumulative production from earliest record to end of 1946, by States, in short tons

State	Maximum production [1]		Production by years											Total production from earliest record to end of 1946
	Year	Quantity	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	
Western States and Alaska:														
Alaska	1916	59,927	18,850	17,336	14,549	128	55	72	22	27	2	5	2	685,866
Arizona	1929	415,314	211,275	288,478	210,797	262,112	281,169	326,317	393,387	403,181	358,303	287,203	289,223	11,178,092
California	1909	28,644	4,381	5,251	806	4,180	6,438	3,943	1,058	8,762	12,721	6,473	4,240	625,824
Colorado	1938	14,171	8,865	10,934	14,171	13,215	12,152	6,748	1,102	1,028	1,048	1,485	1,754	250,711
Idaho	1907	5,445	1,477	2,232	2,139	2,516	3,349	3,621	3,430	2,324	1,688	1,548	1,038	107,787
Montana	1916	176,464	109,544	144,528	77,213	97,827	126,391	128,036	141,194	134,525	118,190	88,506	58,481	6,578,353
Nevada	1942	83,663	70,696	74,603	46,169	66,597	78,454	78,911	83,663	71,068	61,232	52,595	48,616	1,782,668
New Mexico	1942	80,100	3,166	32,053	20,439	46,142	69,848	73,478	80,100	76,163	69,730	56,571	50,191	1,350,199
Oregon	1916	1,791	287	410	38	48	88	83	103	6	3	1	7	12,343
South Dakota	1918	32					6		1		1			106
Texas	1928	224	27	160	16	34	30	6	99	81	115	55	3	1,309
Utah	1943	323,989	126,217	205,994	108,126	171,890	231,864	266,838	306,691	323,989	282,575	226,376	114,284	4,900,441
Washington	1940	9,612	102	64	6,017	8,998	9,612	8,686	8,030	7,315	6,169	5,821	4,527	78,926
Wyoming	1900	2,102					2	4					1	16,326
Total			554,887	782,043	500,480	673,687	819,458	896,743	1,018,880	1,028,469	911,777	726,639	572,367	27,568,951
Central States:														
Michigan	1916	136,846	47,984	47,464	46,743	43,985	45,198	46,440	45,679	46,764	42,421	30,401	21,663	4,819,490
Missouri	1945	3,399	191	269			685	1,400	1,300	1,340	3,302	3,399	1,857	19,678
Wisconsin	1914	5												
Total			48,175	47,733	46,743	43,985	45,883	47,840	46,979	48,104	45,723	33,800	23,520	4,839,168
Eastern States:														
Alabama	1907	42	7	4										(6)
Georgia	1917	465					13							
Maine	1918	383												
Maryland	1917	146												
Massachusetts	1906	5												
New Hampshire	1908	[2] 94												
North Carolina	1930	[3]	[4]	[4]	[4]	[4]	[4]	[4]	[4]	[4]	[4]			
Pennsylvania	1942	[3]	[4]	[4]	[4]	[4]	[4]	[4]	[4]	[4]	[4]	[4]	[4]	
South Carolina	[5]	[5]		1	[4]		[6]	[6]	[6]	[6]				
Tennessee	1930	[3]	[4] 11,447	[4] 12,217	[4] 10,540	[4] 10,648	[4] 12,732	[4] 13,566	[4] 14,174	[4] 13,855	[4] 12,860	[4] 12,385	[4] 12,850	
Vermont	1946	[3]								290	1,898	[4]	[4]	
Virginia	1944	291		[6]	[4]				28	100	291	70		
Total			11,454	12,222	10,540	10,648	12,745	13,566	14,202	14,245	15,049	12,455	12,850	[7] 569,144
Grand total			614,516	841,998	557,763	728,320	878,086	958,149	1,080,061	1,090,818	972,549	772,894	608,737	[7] 32,977,263

[1] For Central and Eastern States, maximum since 1905.
[2] The 1908 volume of Mineral Resources credits this figure to Massachusetts and New Hampshire; the 1909 volume credits it to New Hampshire alone.
[3] Bureau of Mines not at liberty to publish figures.
[4] Tennessee includes other States indicated by footnote "4"; Bureau of Mines not at liberty to publish separate figures.
[5] Not available.
[6] Less than 1 ton.
[7] Largely smelter production for Eastern States.

Mine production [1] of recoverable copper in the United States, 1941–46, by months in short tons

Month	1941	1942	1943	1944	1945	1946
January	[2] 77,160	85,655	91,729	88,820	70,088	55,381
February	[2] 77,160	77,514	85,367	87,622	63,962	41,934
March	[2] 77,160	91,949	93,479	94,446	70,004	42,018
April	79,691	87,922	91,420	88,106	67,493	32,295
May	83,242	93,139	94,919	88,055	72,018	33,526
June	81,880	91,173	89,826	83,480	67,910	33,171
July	79,621	91,987	88,352	76,172	62,100	53,948
August	80,631	87,031	87,510	77,390	61,817	57,163
September	79,236	87,051	90,398	74,846	59,854	62,667
October	82,129	93,814	94,821	73,045	61,555	65,625
November	77,458	94,973	90,942	68,909	58,664	62,336
December	82,781	97,853	92,055	71,658	57,429	68,673
Total	958,149	1,080,061	1,090,818	972,549	772,894	608,737

[1] Monthly data for 1941–44 were based largely on smelter receipts, whereas those for 1945 and 1946 represent actual mine output. All monthly figures have been adjusted to final annual mine-production totals.
[2] Monthly average for first quarter; actual monthly figures not available.

Although mine output of copper reached an annual peak in 1943, the peak monthly total was registered in December 1942. Throughout 1943 production was at capacity levels permitted by the available supply of labor, and lack of adequate labor prevented a higher production rate in 1944. Labor shortages and inefficiencies were almost entirely responsible for the declining production in 1945, whereas the poor showing in the first half of 1946 was due to labor strikes, aggravated by a continuing inadequate supply of labor.

Mine production of copper in the principal districts [1] of the United States, 1942–46 in terms of recovered copper, in short tons

District or region	State	1942	1943	1944	1945	1946
West Mountain (Bingham)	Utah	304,687	322,248	281,100	224,284	112,083
Copper Mountain (Morenci)	Arizona	60,356	84,347	106,926	100,826	95,366
Globe-Miami	do	94,265	100,513	95,305	78,646	88,556
Summit Valley (Butte)	Montana	140,349	133,569	117,363	87,948	57,905
Central (including Santa Rita)	New Mexico	72,724	70,628	65,520	[2] 55,197	[2] 48,806
Robinson (Ely)	Nevada	75,063	64,090	54,651	49,175	45,777
Ajo	Arizona	66,647	70,069	46,250	37,950	45,233
Yavapai County (mostly Verde (Jerome) district).	do	44,941	38,386	32,273	24,903	22,909
Lake Superior	Michigan	45,679	46,764	42,421	30,401	21,663
Mineral Creek (Ray)	Arizona	50,362	37,434	27,452	19,671	16,355
Pioneer (Superior)	do	20,701	18,820	12,722	8,365	12,244
Warren (Bisbee)	do	53,278	50,786	32,683	12,567	4,605
Chelan Lake	Washington	7,955	7,219	6,119	5,803	4,494
Flat Creek	California	----	670	1,292	1,843	[3]
San Juan Mountains	Colorado	539	554	512	1,018	1,333
Lordsburg	New Mexico	3,358	2,496	2,359	1,146	1,196
Ione	California	----	312	237	827	1,004
Coeur d' Alene	Idaho	2,993	1,987	1,289	1,018	810
Burro Mountain	New Mexico	3,656	2,094	1,261	[2]	[2]
Copperopolis	California	264	1,930	2,122	1,123	91
Klamath River	do	2	5,067	7,891	1,526	----
Swain County	North Carolina	[3]	[3]	[3]	----	----
Cope [4]	Nevada	7,074	5,133	[3]	[3]	[3]
Lebanon (Cornwall mine) [4]	Pennsylvania	[3]	[3]	[3]	[3]	[3]
Ducktown [4]	Tennessee	[3]	[3]	[3]	[3]	[3]
Orange County [4]	Vermont	----	290	1,898	[3]	[3]

[1] Districts producing 1,000 short tons or more in any year of the period 1942–46.
[2] Burro Mountain included with Central. Bureau of Mines not at liberty to publish separate figures.
[3] Bureau of Mines not at liberty to publish figures.
[4] Not listed in order of output.

Twenty-five leading copper-producing mines in the United States in 1946, in order of output

Rank	Mine	District	State	Operator	Source of copper
1	Utah Copper	West Mountain (Bingham)	Utah	Kennecott Copper Corp	Copper ore.
2	Morenci	Copper Mountain (Morenci)	Arizona	Phelps Dodge Corp	Do.
3	Anaconda	Summit Valley (Butte)	Montana	Anaconda Copper Mining Co	Copper, zinc, and zinc-lead ores.
4	Chino	Central	New Mexico	Kennecott Copper Corp	Copper ore.
5	New Cornelia	Ajo	Arizona	Phelps Dodge Corp	Do.
6	Inspiration	Globe-Miami	do	Inspiration Cons. Copper Co	Do.
7	Ruth and Copper Flat Pit	Robinson (Ely)	Nevada	Kennecott Copper Corp	Do.
8	Castle Dome	Globe-Miami	Arizona	Castle Dome Copper Co., Inc	Do.
9	Miami	do	do	Miami Copper Co	Do.
10	Consolidated Coppermines Group	Robinson (Ely)	Nevada	Consolidated Coppermines Corp	Do.
11	Ray Mines	Mineral Creek	Arizona	Kennecott Copper Corp	Do.
12	Calumet and Hecla Cons	Lake Superior	Michigan	Calumet and Hecla Cons. Copper Co	Do.
13	United Verde	Verde	Arizona	Phelps Dodge Corp	Do.
14	Magma	Pioneer	do	Magma Copper Co	Do.
15	Burra Burra, Eureka, Boyd, Calloway	Polk County	Tennessee	Tennessee Copper Corp	Copper-bearing pyrites.
16	Bagdad	Eureka	Arizona	Bagdad Copper Corp	Copper.
17	Holden	Chelan Lake	Washington	Howe Sound Co	Zinc-copper ore.
18	Copper Queen	Warren	Arizona	Phelps Dodge Corp	Copper, lead-copper, zinc-lead ores.
19	Isle Royale	Lake Superior	Michigan	Isle Royale Copper Co	Copper ore.
20	Elizabeth	Orange County	Vermont	Vermont Copper Co	Do.
21	Cornwall	Lebanon County	Pennsylvania	Bethlehem Steel Co	Magnetite-pyrite-chalcopyrite ore.
22	Quincy	Lake Superior	Michigan	Quincy Mining Co	Copper-ore tailings.
23	Hornet	Flat Creek	California	The Mountain Copper Co., Ltd	Zinc-copper ore.
24	Mountain City	Cope	Nevada	Mountain City Copper Co	Copper ore.
25	Apex-Delaware	West Mountain (Bingham)	Utah	National Tunnel and Mines Co	Copper, zinc-lead ores.

The first 5 mines listed produced 58 percent of the United States total; 10 produced 80 percent, and the entire 25 accounted for 96 percent.

Quantity and Estimated Recoverable Content of Copper-Bearing Ores.—The following tables list the quantity and estimated recoverable copper content of the ore produced by mines in the United States in 1945; complete details for 1946 are not yet available. Of the total copper produced from copper ores in the United States during 1945, 92 percent was obtained from ores concentrated before smelting, 5 percent from direct-smelting ores, and nearly 3 percent from ore treated by straight leaching. The percentages for 1945 compared with 90 percent obtained from concentrated ore, 7 percent from direct-smelting ores, and 3 percent by straight leaching in 1944.

Close agreement between the output as reported by smelters and the recoverable quantity as reported by mines indicates that estimated recoverable tenor is close to actual recovery. Classification of some of the complex western ores is difficult and more or less arbitrary. "Copper ores" include not only all those that contain 2.5 percent or more recoverable copper but also those that contain less than this percentage if they are valuable chiefly for copper, notably the "porphyry ores." Mines report considerable copper from ores mined primarily for other metals. These include siliceous gold and silver ores, lead and zinc ores, and pyritic ores.

Copper ore, old tailings, etc., sold or treated in the United States in 1945, with copper, gold, and silver content in terms of recovered metals

State	Ore, old tailings, etc., sold or treated (short tons)	Copper produced		Gold produced (fine ounces)	Silver produced (fine ounces)	Value of gold and silver per ton of ore
		Pounds	Percent			
Alaska	6	10,000	83.33	3	38	$22.00
Arizona	30,644,470	[1] 548,501,577	.89	62,265	2,113,537	.12
California	311,326	[1] 7,076,800	1.14	796	19,354	.13
Colorado	7,230	465,552	3.22	92	23,017	2.71
Idaho	8,569	483,229	2.82	532	8,968	2.92
Michigan	5,196,932	60,802,000	.58		21,863	
Montana	4,463,131	[1] 169,568,504	1.90	11,378	4,487,436	.80
Nevada	4,917,945	[1] 99,946,800	1.02	51,340	270,607	.40
New Mexico	6,228,727	[1] 87,210,093	.70	557	23,460	.01
Texas	1,600	88,000	2.75		408	.18
Utah	23,978,159	[1] 425,948,188	.89	229,526	2,087,402	.40
Washington [2]	617,158	11,616,600	.94	40,211	120,700	2.42
Eastern States	1,097,730	[3] 24,896,000		252	56,370	
Total	[2] 77,472,983	[3] 1,436,613,343	.93	396,952	9,233,160	.26

[1] Excludes copper recovered from precipitates as follows: Arizona, 20,193,515 pounds; California, 22,000 pounds; Montana, 5,803,665 pounds; Nevada, 4,459,300 pounds; New Mexico, 23,855,551 pounds; and Utah, 22,787,627 pounds.

[2] Includes ore from Washington classed as zinc-copper ore and copper, gold, and silver recovered therefrom.

[3] Copper from magnetite-pyrite-chalcopyrite ore from Pennsylvania included with that from copper ore.

Copper ore, old tailings, etc., concentrated in the United States in 1945, with content in terms of recovered copper

State	Ore, old tailings, etc., concentrated (short tons)	Concentrates produced (short tons)	Copper produced (pounds)	Copper from ore, etc. (percent)
Arizona	[1] 27,504,269	869,684	[2] 455,187,391	0.83
California	296,079	14,360	5,394,000	.91
Colorado	65	8	3,328	2.56
Idaho	1,850	165	74,629	2.02
Michigan	5,196,932	48,734	60,802,000	.58
Montana	4,418,846	379,894	166,626,941	1.89
Nevada	4,832,676	198,919	94,172,900	.97
New Mexico	6,168,925	173,301	85,384,293	.69
Utah	23,969,590	690,592	424,736,363	.89
Washington [3]	617,120	30,466	11,605,600	.94
Eastern States	952,313	[4] 70,522	[5] 23,551,254	
Total	73,958,665	[4] 2,476,645	[5] 1,327,538,699	.90

[1] In addition, 2,477,471 tons were treated by straight leaching.
[2] In addition, 36,150,953 pounds of copper were recovered by straight leaching.
[3] Includes ore classed as zinc-copper ore.
[4] Includes concentrates from magnetite-pyrite-chalcopyrite ore from Pennsylvania.
[5] Includes copper from magnetite-pyrite-chalcopyrite ore from Pennsylvania.

Copper ore, old tailings, etc., smelted in the United States in 1945, with content in terms of recovered copper, and copper produced from all sources, in terms of recovered copper

State	Ore, old tailings, etc., smelted			Copper from all sources, including old slags, smelter cleanings, and precipitates (pounds)
	Short tons	Copper produced (pounds)	Percent of copper	
Alaska	6	10,000	83.33	10,000
Arizona	662,730	57,163,233	4.31	[1] 574,406,000
California	15,247	1,682,800	5.52	[2] 12,946,000
Colorado	7,165	462,224	3.23	[3] 2,970,000
Idaho	6,719	408,600	3.04	[3] 3,096,000
Michigan				60,802,000
Missouri				6,798,000
Montana	44,285	2,941,563	3.32	[1] 177,012,000
Nevada	85,269	5,773,900	3.39	[1] 105,190,000
New Mexico	59,802	1,825,800	1.53	[1] 113,142,000
Oregon				2,000
Texas	1,600	88,000	2.75	110,000
Utah	8,569	1,211,825	7.07	[1] 452,752,000
Washington	38	11,000	14.47	11,642,000
Eastern States	145,417	1,344,746	.46	24,910,000
Total	1,036,847	72,923,691	3.52	1,545,788,000

[1] Considerable copper was recovered from precipitates.
[2] Considerable copper was recovered from ores classed as zinc-copper and zinc ores.
[3] Mostly from ores not classed as copper ores.

Copper ores produced in the United States, 1941–45, and average yield in copper, gold, and silver

Year	Smelting ores [1]		Concentrating ores [1]		Total				
	Short tons	Yield in copper (percent)	Short tons	Yield in copper (percent)	Short tons [1]	Yield in copper (percent)	Yield per ton in gold (ounce)	Yield per ton in silver (ounce)	Value per ton in gold and silver
1941	2,135,138	4.29	72,531,712	1.06	78,452,504	1.15	.0071	.239	$0.42
1942	2,221,191	4.00	85,865,167	1.02	92,285,626	1.09	.0063	.162	.34
1943	2,151,187	3.64	92,246,622	.97	98,119,735	1.04	.0055	.142	.29
1944	1,539,436	3.84	86,392,852	.94	91,063,648	.99	.0050	.130	.27
1945	1,036,847	3.52	73,958,665	.90	[2] 77,472,983	.93	.0051	.119	.26

[1] Includes old tailings, etc.
[2] Includes ore from Washington classed as zinc-copper ore.

Smelter Production.—The recovery of copper by smelters in the United States from ores of domestic origin totaled 599,656 short tons in 1946, a decline of 23 percent from the total of 782,726 for 1945. Domestic smelter output constituted 51 percent of the world production during 1925–29 but dropped sharply in the succeeding years until 1934, when it was only 17 percent. From 1936 to 1940 it fluctuated between 25 and 33 percent, in 1942–44 it is believed to have been slightly above 35 percent, and in 1946 it stood at about 30 percent.

The figures for smelter production are based upon returns from all smelters handling copper-bearing materials produced in the United States. For Michigan the sum of furnace-refined copper and copper cast into anodes for electrolytic refining is included. The figures for blister copper represent the fine-copper content. Some casting and electrolytic copper produced direct from ore or matte is included in the smelter production. Metallic and cement copper recovered by leaching is included in smelter production.

The quantity, in pounds, of copper produced by smelters in the United States and its value are shown by years for 1845–1930 in the Copper chapter of Mineral Resources of the United States, 1930, part I.

Copper produced (smelter output) in the United States, 1942–46, and total, 1845–1946

Year	Short tons	Value [1]
1942	1,087,991	$256,766,000
1943	1,092,939	257,934,000
1944	1,003,379	236,797,000
1945	782,726	184,723,000
1946	599,656	172,701,000
Total, 1845–1946	33,031,241	9,588,934,000

[1] Excludes bonus payments of Office of Metals Reserve.

Refinery Production.—The refinery output of copper in the United States in 1946 was made by 11 plants; 8 of these employed the electrolytic method only, 1 the furnace process on Lake Superior copper, 1 the furnace process on western ores, and 1 both the electrolytic and the furnace methods.

Five large electrolytic refineries are on the Atlantic seaboard, three

Lake refineries on the Great Lakes, and three electrolytic refineries west of the Great Lakes—one at Great Falls, Mont.; one at Tacoma, Wash.; and one at El Paso, Tex. In 1942 fire-refined copper was produced for the first time at the Hurley, N. Mex., plant of the Kennecott Copper Corp., and all of the plant output was treated by this method in 1946. The El Paso plant of the Phelps Dodge Refining Corp. produced furnace-refined copper in addition to the usual electrolytic grade. Of the plants specified above, the Lake refinery of the Copper Range Co. was idle throughout 1946, and that of the Quincy Mining Co. has been idle since 1933.

In addition to the plants in the preceding paragraph, but included in the 11 active refineries noted, is the plant at Inspiration, Ariz., which is equipped to make electrolytically refined copper direct from the liquors obtained from leaching. Usually all of this copper is shipped as cathodes to other refineries, where it is melted and cast into merchant shapes. In 1946, however, more than one-third went directly to consuming plants.

The 13 plants indicated constitute what commonly are termed "regular refineries," and in 1946 the Inspiration plant should be added because it shipped direct to consumers. Of these plants, nine employ the electrolytic process, four the furnace process, and one both methods. The electrolytic plants, exclusive of the one at Inspiration, have a rated capacity of 1,546,000 tons of refined copper a year. They produced at the rate of 56 percent of capacity in 1946.

The accompanying tables show the production of refined copper at regular refining plants, classified according to source, grade, and form in which cast.

Primary and secondary copper produced by regular refining plants in the United States and imported, 1942–46, in short tons

	1942	1943	1944	1945	1946
Primary:					
Domestic: [1]					
Electrolytic [2]	963,177	938,727	837,089	669,705	475,571
Lake [2]	46,523	44,867	41,597	29,995	21,567
Casting	55,092	98,485	95,166	76,038	81,291
	1,064,792	1,082,079	973,852	775,738	578,429
Foreign: [1]					
Electrolytic	343,834	297,184	247,335	298,128	300,233
Casting and best select	5,935			34,733	
Refinery production, new copper	1,414,561	1,379,263	1,221,187	1,108,599	878,662
Imports, refined copper [3]	401,436	402,762	492,395	531,367	154,371
Total new refined copper made available	1,815,997	1,782,025	1,713,582	1,639,966	1,033,033
Secondary:					
Electrolytic [4]	83,079	114,259	78,402	[5] 84,044	[5] 97,615
Casting	2,064	8,205	7,996	12,618	7,957
	85,143	122,464	86,398	96,662	105,572
Grand total	1,901,140	1,904,489	1,799,980	1,736,628	1,138,605

[1] The separation of refined copper into metal of domestic and foreign origin is only approximate, as accurate separation at this stage of manufacture is not possible.
[2] Some copper from Michigan is electrolytically refined at eastern refineries and is included as electrolytic copper.
[3] Data include copper imported for immediate consumption plus material entering country under bond.
[4] Includes some secondary Lake copper.
[5] Copper from scrap at Lake refineries included under "casting" copper in 1945–46. Includes a little copper reported from foreign scrap in 1945–46.

Copper cast in forms in the United States, 1945–46

Form	1945		1946	
	Short tons	Percent	Short tons	Percent
Wire bars	467,000	38	502,000	51
Cakes	153,000	13	142,000	14
Cathodes	231,000	19	115,000	12
Ingots	213,000	18	102,000	10
Other forms	141,000	12	123,000	13
Total	1,205,000	100	984,000	100

In addition to the regular refineries, many plants throughout the country operate on scrap exclusively, producing metallic copper and a variety of alloys. The output of these plants is not included in the statements of refined-copper production in the preceding tables but is included in the following statement on secondary-copper production.

Copper Sulfate.—The production of hydrous copper sulfate or bluestone by copper refineries in the United States was 20,300 short tons, having a copper content of 5,070 tons in 1946 compared with 32,900 tons containing 8,237 tons in 1945. The output of copper sulfate by plants other than the regular primary refineries totaled 107,500 tons with a reported content of 26,886 tons in 1946, compared with 92,600 tons containing 23,154 tons of copper in 1945. Producers held 9,400 tons of copper sulfate at the beginning of 1946, total production was 127,800 tons, and shipments amounted to 124,700 tons. Some small purchases were made by producers during the year, and producers used a quantity equivalent to 3 percent of shipments. Inventories at the year end were 13,000 tons.

SECONDARY COPPER

Secondary copper includes material recovered from remelting old copper and copper scrap and from the treatment of copper alloys or alloys treated without separation of the copper. The following table summarizes the production of secondary copper during 1942–46. Further details appear in the Secondary Metals—Nonferrous chapter of this volume.

Secondary copper produced in the United States, 1942–46, in short tons

	1942	1943	1944	1945 [1]	1946
Copper recovered as unalloyed copper	114,647	137,883	102,135	112,856	136,909
Copper recovered in alloys [2]	813,108	948,164	848,807	893,660	666,637
Total secondary copper	927,755	1,086,047	950,942	1,006,516	803,546
From new scrap	500,633	658,526	494,232	509,421	397,093
From old scrap	427,122	427,521	456,710	497,095	406,453
Percentage equivalent of domestic mine output	86	100	98	130	132

[1] Revised figures.
[2] Includes copper in chemicals, as follows: 1942, 17,455; 1943, 13,019; 1944, 13,357; 1945, 18,666; 1946, 19,192.

CONSUMPTION

The following table gives figures on apparent consumption of copper in the United States, and data for a long period are available on this

basis. In estimating apparent consumption it has been assumed that copper used in the manufacture of primary fabrications of copper is consumed. Statistics compiled upon a different basis (for example, by taking consumption as including only copper made into automobiles, electrical equipment, ships, and other items) would show very different results. Much copper leaves the country as primary fabrications and considerably more in manufactured products containing copper. The method of calculating the quantity of copper available for consumption is shown in the following table. It should be noted that exports and stocks include some refined secondary copper that cannot be determined separately and also that actual consumption of new copper would differ from the figures shown in the table by the changes in the consumers' stocks.

New refined copper withdrawn from total year's supply on domestic account, 1942–46, in short tons

	1942	1943	1944	1945	1946
Total supply of new copper	1,815,997	1,782,025	1,713,582	1,639,966	1,033,033
Stock at beginning of year	77,500	84,000	68,500	81,000	130,000
Total available supply	1,893,497	1,866,025	1,782,082	1,720,966	1,163,033
Copper exported [1]	131,406	175,859	68,373	48,563	52,629
Stock at end of year	84,000	68,500	81,000	130,000	96,000
	215,406	244,359	149,373	178,563	148,629
Withdrawn on domestic account [2]	1,608,000	1,502,000	1,504,000	1,415,000	1,391,000

[1] Includes refined copper in ingots, bars, or other forms.
[2] Adjusted for Office of Metals Reserve stock changes. Data for 1942–45 are revised.

The Bureau of Mines began to compile figures on actual consumption of copper in 1945. The results of the first 2 years' canvasses are given in the following table. Unlike the foregoing table, which attempts to eliminate all but new copper from measurement, the following one does not distinguish between new and old copper. It covers copper consumed in refined form.

Refined copper consumed [1] in 1945–46, by classes of consumers, in short tons

Form	Wire mills	Brass mills	Chemical plants	Secondary smelters	Foundries and miscellaneous	Total
1945						
Cathodes	14	239,072	105	7,943	11,585	258,719
Wire bars	504,129	57,949			326	562,404
Ingots and ingot bars	15,438	219,343	215	10,543	30,405	275,944
Cakes and slabs		158,061	4,800	101	61	163,023
Billets	1	108,364	67	120	433	108,985
Other		1,880	5,111	9	3,197	10,197
Total	519,582	784,669	10,298	18,716	46,007	1,379,272
1946						
Cathodes	1,803	95,786	60	17,180	2,263	117,092
Wire bars	428,893	56,834			225	485,952
Ingots and ingot bars	15,238	174,824	4,432	12,705	21,954	229,153
Cakes and slabs		187,614		206	180	188,000
Billets		104,156		250	645	105,051
Other		1,678	5,661	329	2,282	9,950
Total	445,934	620,892	10,153	30,670	27,549	1,135,198

[1] Reported consumption.

STOCKS

The following table gives domestic stocks of copper as reported by primary smelting and refining plants. Stocks of blister and anode copper in transit from smelters to refineries are included under blister copper.

Stocks of copper at primary smelting and refining plants in the United States at end of year, 1942–46, in short tons

Year	Refined copper	Blister and materials in process of refining [1]	Year	Refined copper	Blister and materials in process of refining [1]
1942	84,000	235,500	1945	130,000	331,000
1943	68,500	241,000	1946	96,000	254,000
1944	81,000	311,000			

[1] Includes copper in transit from smelters in the United States to refineries therein.

Producers' (smelters and refineries) stocks of crude and refined copper dropped sharply in 1946, whereas fabricators' inventories of refined, "in process," and primary fabricated copper shapes gained; but industry stocks showed an over-all decline nonetheless.

At the end of 1946 the Office of Metals Reserve held 92,758 tons of electrolytic and fire-refined copper in cathodes, shapes, and "in process" copper, all of which was in the United States. The foregoing total represents a decrease of 84 percent from the 565,710 tons held at the end of 1945, a small part of which was in Canada. The foregoing stocks are upon an ownership basis and therefore duplicate, in part, stocks of refined and "in process" copper reported by the refineries, which are on a physical-plant basis. The Yearbook of the American Bureau of Metal Statistics, 1946 (p. 7), gave Metals Reserve stocks as 472,000 and 95,388 tons at the beginning and end of 1946. The last two figures apparently exclude the duplication mentioned.

Stocks of copper in fabricators' hands at end of year, 1942–46, in short tons

	Stocks of refined copper [1]	Unfilled purchases of refined copper from producers	Working stocks	Unfilled sales to customers	Excess stocks over orders booked
1942	414,668	135,481	340,547	613,005	−403,403
1943	353,948	90,807	299,796	465,258	−320,299
1944	334,017	53,538	289,160	285,654	−187,259
1945	375,618	44,100	268,490	362,436	−211,208
1946	408,943	59,421	286,418	526,628	−344,702

[1] Includes in-process metal and primary fabricated shapes. Also includes small quantities of refined copper held at refineries for fabricators' account.

Metal held by fabricators rose from 375,618 tons at the beginning of 1946 to 408,943 tons at the end. Unfilled sales to customers, however, gained for the second successive year and were the largest since the peak year-end total of 613,005 tons at the end of 1942. The excess of booked orders over stocks at the end of 1946, as a consequence, increased for the second successive year and was 344,702 tons, compared with 211,208 at the beginning of the year.

Figures compiled by the Copper Institute show that domestic stocks of refined, duty-free copper increased from 76,512 tons at the end of 1945 to 80,832 tons at the end of 1946. Inventory data of the Copper Institute and the Bureau of Mines are on different bases and,

as a result, never agree. Under usual conditions the differences are due, in part, to somewhat different coverage and in part to use by the Copper Institute of an arbitrary method, based on tariff practice, in designating the copper as domestic or foreign metal. Copper produced from foreign crude materials and held at refineries at the end of the year is included in Bureau of Mines inventory figures.

PRICES

Reports to the Bureau of Mines from copper-selling agencies indicate that 608,000 short tons of copper were delivered to domestic and foreign purchasers (excluding deliveries of foreign copper to the Office of Metals Reserve) in 1946 at an average price (f. o. b. refinery) of 14.4 cents a pound, or 22 percent above the level prevailing for the years 1941–45. The averages for 1942–46 exclude bonuses paid for overquota outputs of individual mines, which were first applicable to February 1942 tonnages. The following table gives details covering bonus payments for 1943 to 1946.

Salient statistics covering bonus payments [1] of the Government, 1943–46

	1943		1944		1945		1946	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Production:								
At ceiling price	841,286	77.12	722,791	74.53	561,851	72.57	392,828	65.22
At overceiling prices:								
Under Premium Price Plan—								
A quota only (17 cents a pound)	217,382	19.93	194,483	20.06	179,389	23.17	[2] 98,219	[2] 16.31
Special (17.01–27 cents a pound)	14,003	1.28	26,168	2.70	22,917	2.96	[2] 87,060 [3] 24,248	[2] 14.45 [3] 4.02
	231,385	21.21	220,651	22.76	202,306	26.13	209,527	34.78
Metals Reserve mine contracts	18,147	1.67	26,347	2.71	10,075	1.30		
Total overceiling production	249,532	22.88	246,998	25.47	212,381	27.43	209,527	34.78
Total production	1,090,818	100.00	969,789	100.00	774,232	100.00	602,355	100.00
	Total	Price per pound (cents)	Total	Price per pound (cents)	Total	Price per pound (cents)	Total	Price per pound (cents)
Payments:								
Under Premium Price Plan—								
A quota only	$23,138,490	17.00	$22,065,137	17.00	$20,230,618	17.00	[2] $13,684,190	[2] 19.59
Special	1,735,266	23.20	3,450,898	23.59	3,198,357	23.98	[2] 7,270,723 [3] 1,559,173	[2] 21.18 [2] 22.39
	24,873,756	17.38	25,516,035	17.78	23,428,975	17.79	22,514,086	15.70
Metals Reserve mine contracts	3,488,489	21.61	4,258,562	20.08	2,115,933	22.50		
Total overceiling payments	28,362,245	17.68	29,774,597	18.03	25,544,908	18.01	22,514,086	15.70
Total United States production		13.30		13.54		13.65		13.83

[1] From published and unpublished reports of the Office of Price Administration and the Office of Premium Price Plan for Copper, Lead, Zinc, and Manganese.
[2] January–October. "A" and "Special" quotas and premium payments for November and December are not separable and are shown with footnote 3.
[3] Total "A" and "Special" quotas and premium payments for November and December; separation by kinds not available.

Average monthly quoted prices of electrolytic copper for domestic and export shipments, f. o. b. refineries, in the United States, 1945–46, in cents per pound

Month	1945			1946		
	Domestic f. o. b. refinery [1]	Domestic f. o. b. refinery [2]	Export f. o. b. refinery [2]	Domestic f. o. b. refinery [1]	Domestic f. o. b. refinery [2]	Export f. o. b. refinery [2]
January	11.87	11.775	11.700	11.87	11.775	11.700
February	11.87	11.775	11.700	11.87	11.775	11.700
March	11.87	11.775	11.700	11.87	11.775	11.842
April	11.87	11.775	11.700	11.87	11.775	12.159
May	11.87	11.775	11.700	11.87	11.775	13.780
June	11.87	11.775	11.700	14.15	14.055	14.430
July	11.87	11.775	11.700	14.25	14.150	15.406
August	11.87	11.775	11.700	14.25	14.150	16.091
September	11.87	11.775	11.700	14.25	14.150	16.486
October	11.87	11.775	11.700	14.25	14.150	17.094
November	11.87	11.775	11.700	17.08	17.036	17.619
December	11.87	11.775	11.700	19.37	19.275	19.183
Average for year	11.87	11.775	11.700	13.92	13.820	14.791

[1] As reported by The American Metal Market Co.
[2] As reported by Engineering and Mining Journal.

Average yearly quoted prices of electrolytic copper for domestic and export shipments, f. o. b. refineries, in the United States and for spot copper at London, 1937–46, in cents per pound

	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946
Domestic f. o. b. refinery [1]	13.27	10.10	11.07	11.40	11.87	11.87	11.87	11.87	11.87	13.92
Domestic f. o. b. refinery [2]	13.167	10.000	10.965	11.296	11.797	11.775	11.775	11.775	11.775	13.820
Export f. o. b. refinery [2]	13.018	9.695	10.727	10.770	10.901	11.684	11.700	11.700	11.700	14.791
London spot [2 3]	13.097	9.912	[4] 10.066	([5])	([5])	([5])	([5])	([5])	([5])	([5])

[1] As reported by The American Metal Market Co.
[2] As reported by Engineering and Mining Journal.
[3] Conversion of English quotations into American money based on average rates of exchange recorded by Federal Reserve Board.
[4] Average for 8 months; thereafter, London Metal Exchange dealings suspended.
[5] No quotations. See text for official maximum price changes.

The ceiling price limitations, placed on copper by the Office of Price Administration effective August 12, 1941, after remaining unchanged for almost 5 years, were raised, effective June 3, 1946, from 12 cents to 14⅜ cents per pound (electrolytic delivered Connecticut Valley), contingent upon the completion of certain wage agreements. On July 1 began a period of uncertainty between the termination of the OPA and the signing on July 25 of a bill extending it, effective July 26. On November 10 all price controls on copper were removed, and in the resulting free market the price rose immediately to 17.5 cents; by year end the price had advanced to 19.5 cents.

The Premium Price Plan, described in earlier chapters of this series, expired June 30, 1946, but was later extended to June 30, 1947, with benefits retroactive to the expiration date of the earlier legislation. The accompanying table presents details of the plan's operations, 1943–46.

Official maximum prices in the London market were unchanged from December 18, 1939, at £62 per long ton for electrolytic copper until April 8, 1946, when it was raised £10 to £72; subsequently the price was boosted to £84, effective July 1, to £98, effective November 13, and to £117, effective January 1, 1947, the upward movement being extended further in 1947.

FOREIGN TRADE[1]

The prewar movement of copper from producing to consuming centers was widely disrupted by the war. Before the war the United States, through its smelting, refining, and fabricating facilities, handled large quantities of foreign crude materials, which were subsequently exported in finished form for consumption abroad. Such copper was not subject to the United States import tax because the copper was not for ultimate consumption here. With the onset of World War II in 1939, United States needs for copper for its huge armament requirements absorbed all the copper that entered the country. The prewar flow was not resumed after the end of hostilities largely because of the enormous demand in the United States and the barriers to trade imposed by various governments.

IMPORTS

The unmanufactured copper entering the United States in each of the six classifications shown in the accompanying table declined in 1946 compared with 1945, and the total unmanufactured copper imports decreased over one-half. The decrease in unrefined black blister and converter copper, the second largest class in 1945, was small as compared with that in refined copper, with the result that this class was the most important source of imported copper in 1946. Much smaller imports from Africa accounted for the reduction. The sources of refined copper in ingots, plates, and bars in 1945, except the Union of South Africa, either sharply reduced shipments to the United States or sent nothing at all. Substantial shipments of regulus, black or coarse copper, and cement from Belgian Congo in 1945 were not continued into 1946. Imports in ore, concentrates, old and scrap copper fit only for remanufacture, and scale and clippings, though smaller in 1946 than 1945, did not constitute a principal source of imported copper in either year.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Copper (unmanufactured) imported into the United States, 1945–46, by countries, in short tons [1]

Country	Ore (copper content)	Concentrates (copper content)	Regulus black or coarse copper and cement (copper content)	Unrefined black blister and converter copper in pigs or converter bars	Refined in ingots, plates, or bars	Old and scrap copper, fit only for remanufacture, and scale and clippings
1945						
Australia	(2)	102	909			137
Belgian Congo			18,084	29,758	[3] 41,782	
Bolivia	350	4,579	10			
Canada		13,117	456		76,392	1,186
Chile	7,185	5,190		54,855	384,843	
Cuba	216	9,206				
Ecuador		4		3,622		
Mexico	121	7,599	8	58,841	44	
Mozambique					1,665	
Newfoundland and Labrador		4,463				
Northern Rhodesia [4]		414	8	64,374	25,166	
Peru	983	3,795	368	25,537	692	
Union of South Africa		150	19	6,114	783	
Other countries	3	13				53
Total	8,858	48,632	19,862	243,101	531,367	1,376
1946						
Australia		8				71
Belgian Congo	(2)			4,469		
Bolivia		4,573				
Canada	1	8,353	160		17,193	520
Chile	1,279	2,191	1	66,867	136,312	37
Cuba		12,378				
Ecuador		44		2,931		3
Mexico	3,242	5,038	338	54,858		
Newfoundland and Labrador		3,231	2			22
Northern Rhodesia [4]	2	258		11,682		
Peru	99	3,731	164	26,380		
Turkey				17,414		
Union of South Africa		137	64	4,297	866	32
United Kingdom				3,323		63
Other countries	161	119	3			358
Total	4,784	40,061	732	192,221	154,371	1,106

[1] Data include copper imported for immediate consumption plus material entering the country under bond.
[2] Less than 1 ton.
[3] Refined copper credited to Portuguese Guinea and Angola by the U. S. Department of Commerce has been added to Belgian Congo.
[4] Tonnages credited to Southern Rhodesia by the U. S. Department of Commerce have been added to Northern Rhodesia.

Copper (unmanufactured) imported [1] into the United States, 1942–46

Year	Short tons	Year	Short tons
1942	764,393	1945	853,196
1943	716,596	1946	393,275
1944	785,211		

[1] Data include copper imported for immediate consumption plus material entering country under bond.

EXPORTS

Much of the decline in copper exports in 1946 compared with 1945 was accounted for in the decrease in wire shipments, particularly insulated wire and cable. Despite the fact that the reduction in shipments to Russia was large enough to account for most of the decrease in wire, the U. S. S. R. continued to be the destination for much of the exports in 1946, receiving 44 percent of the insulated wire

Copper exported from the United States, 1946, by countries, in short tons

Country	Ore, concentrates, composition metal, and unrefined copper (copper content)	Refined		Old and scrap	Pipes and tubes	Plates and sheets	Wire (except insulated)	Insulated wire and cable	Other copper manufactures
		Bars, ingots or other forms	Rods						
Algeria		565	3		13	30	5	438	
Argentina	(1)	1,427	4		115	6	385	424	
Australia		56			(1)		4	125	
Belgium and Luxembourg		728			10	2	1	7	
Brazil	(1)	4,453	96	14	465	879	277	457	
Canada	12	62	84	23	599	619	70	1,243	
Canal Zone		14	(1)		5	7	1	235	
Chile		165	1		24	2	25	736	
China	5	2,010	6		49	56	492	570	
Colombia		9	1		83	137	397	969	
Cuba	1	4	11	2	445	68	268	1,122	
Dominican Republic		1	(1)		17	7	120	72	
France		10,457	(1)	765		(1)	100	688	
French Indo-China		3					72	242	
India		5,651			14	6	8	223	
Mexico	3	833	35	2	496	245	127	1,186	(2)
Morocco, French			2		1		8	160	
Netherlands		1,288	1,061		13	7	3	14	
Norway		415	270		11			121	
Panama, Republic of			1		59	7	22	131	
Peru		1	7		31	33	72	340	
Philippines, Republic of	(1)	4	2		9	7	248	1,106	
Portugal		255	2		26	138	96	99	
Sweden		8,674			114	23	6	317	
Switzerland		6,180	727	103	52	(1)	27	2	
Turkey		57	84		24	711	279	788	
Union of South Africa		(1)			56	35	4	277	
U. S. S. R.		43	24			24	177	13,351	
United Kingdom		6,553				(1)		44	
Uruguay		77			38	29	390	1,996	
Venezuela	1	1	5		51	136	223	1,024	
Other countries	1	2,643	26		111	473	592	1,861	
Total: Short tons	23	52,629	2,452	909	2,931	3,687	4,499	30,368	(2)
Value	$11,857	$14,166,392	$711,986	$214,337	$1,835,708	$1,973,996	$1,767,310	$16,432,625	$1,472,662

[1] Less than 1 ton.
[2] Weight not recorded.

and cable. Exports of refined copper, which in 1946 resumed its prewar place as the most important class of copper exports, rose slightly in quantity and substantially in value in 1946 compared with 1945. The United Kingdom—leading destination from 1941 to 1945 inclusive—dropped to third place in 1946. France and Sweden occupied the first two places. There was little change in the quantity and value of plates and sheets exported, but exports of pipes and tubes decreased sharply in quantity and value. Exports of old copper and scrap increased greatly but remained a small item compared to the other classes.

Copper exported from the United States, 1942–46

Year	Ore, concentrates, composition metal, and unrefined copper (copper content)	Refined copper and primary manufactures	Total (except "Other copper manufactures")	Other copper manufactures [1]	Grand total
	Short tons			Value	
1942	3,424	210,560	213,984	$78,588,440	$3,759,403	$82,347,843
1943	1,240	294,459	295,699	107,598,224	1,121,230	108,719,454
1944	[2]	237,515	237,515	101,837,979	859,421	102,697,400
1945	34	132,555	132,589	54,212,247	1,000,008	55,212,255
1946	23	97,475	97,498	37,114,211	1,472,662	38,586,873

[1] Weight not recorded.
[2] Less than 1 ton.

Brass and bronze exported from the United States, 1945–46, by classes

Class	1945		1946	
	Short tons	Value	Short tons	Value
Ingots	5,935	$1,517,195	1,708	$485,110
Scrap and old	421	82,946	1,184	301,056
Bars and rods	8,662	3,248,471	4,244	1,756,332
Plates and sheets	25,181	9,287,821	3,038	1,615,675
Pipes and tubes	1,759	1,083,399	1,712	1,080,028
Pipe fittings	285	469,933	360	549,646
Plumbers' brass goods	372	558,702	913	1,723,906
Wire of brass or bronze	1,548	1,080,242	2,338	1,768,803
Brass wood screws	[1]	117,394	[1]	123,693
Hinges and butts of brass or bronze	[1]	45,605	[1]	120,264
Other hardware of brass or bronze	[1]	285,923	[1]	557,127
Other brass or bronze manufactures	[1]	3,271,884	[1]	5,039,066
Total		21,049,515		15,120,706

[1] Weight not recorded.

Unmanufactured brass exported from the United States, 1942–46

[Ingots, bars and rods, and plates and sheets]

Year	Short tons	Value	Year	Short tons	Value
1942	74,129	$27,860,957	1945	33,781	$11,833,013
1943	94,617	36,347,655	1946	8,990	3,857,117
1944	128,852	46,610,439			

Copper sulfate (blue vitriol) exported from the United States, 1942–46

Year	Short tons	Value	Year	Short tons	Value
1942	35,082	$3,443,922	1945	34,967	$3,419,332
1943	30,367	3,074,668	1946	41,345	4,076,850
1944	28,922	2,843,941			

WORLD REVIEW

The sharp decline in world production of copper in 1946 was due largely to labor strikes, accompanied by a labor shortage, in the United States, causing a 21-percent drop in domestic mine output; but labor problems elsewhere and shortages of coal and hydroelectric power in some countries were contributory factors, as shown by the accompanying discussion.

World mine production of copper, 1940–46, in metric tons

[Compiled by B. B. Mitchell]

Country	1940	1941	1942	1943	1944	1945	1946
North America:							
Canada	297,371	291,802	273,815	260,900	248,145	215,416	168,321
Cuba	10,500	9,838	[1] 8,916	6,405	6,584	9,067	11,321
Mexico	37,602	48,716	51,379	49,774	41,302	61,680	61,054
Newfoundland	9,426	6,651	5,666	5,669	5,021	4,693	4,458
United States	796,582	869,214	979,811	989,568	882,277	701,154	552,234
Total	1,151,481	1,226,221	1,319,587	1,312,316	1,183,329	992,010	797,388
South America:							
Bolivia [1]	6,660	7,274	6,376	6,011	6,170	6,097	6,127
Chile	352,010	465,467	489,158	509,378	498,520	446,398	360,935
Ecuador [2]	1,462	3,209	1,587	4,418	3,720	3,289	2,699
Peru	43,965	36,822	35,332	33,407	32,396	31,916	24,592
Total	404,097	512,772	532,453	553,214	540,806	487,700	394,353
Europe:							
Austria	20	(3)	982	1,365	1,500	320	125
Bulgaria	560	(3)	(3)	(3)	(3)	(3)	(3)
Finland	15,355	16,627	16,102	16,363	15,841	14,978	17,599
France	644	561	317	149	82	----------	23
Germany [4]	30,000	24,000	23,000	21,600	23,500	(3)	14,970
Hungary	450	990	980	910	[5] 750	(3)	(3)
Italy [6]	4,536	4,808	1,996	1,905	----------	----------	(3)
Norway	15,529	17,988	15,471	16,248	14,462	5,203	(3)
Spain [6]	13,000	9,300	10,700	11,100	11,000	8,300	8,600
Sweden	9,490	13,390	18,056	17,832	16,121	14,926	16,329
U. S. S. R. [4 7 8]	157,000	160,000	160,000	130,000	130,000	160,000	(3)
Yugoslavia [8]	42,951	23,000	32,000	27,000	22,700	(3)	(3)
Total	289,535	271,000	280,000	245,000	236,500	[4] 223,000	(3)
Asia:							
China [8 9]	2,269	1,590	1,255	1,146	1,030	623	947
Cyprus [1]	6,040	----------	----------	5,177	1,422	----------	2,633
Formosa	6,238	5,621	5,067	6,020	3,985	(3)	(3)
India and Burma [4]	14,000	13,000	13,000	12,000	11,000	11,000	(3)
Japan	[10] 73,930	[10] 77,043	[10] 83,058	[10] 94,729	[10] 86,842	[11] 17,496	17,173
Netherlands Indies	----------	(3)	60	60	60	(3)	(3)
Philippines, Republic of	9,259	[4] 9,900	(3)	(3)	(3)	(3)	----------
Turkey	8,754	10,507	8,257	10,000	11,050	[5] 9,800	[5] 10,050
U. S. S. R.	(7)	(7)	(7)	(7)	(7)	(7)	(7)
Total	120,490	117,700	[4] 122,000	[4] 140,000	[4] 120,000	(3)	(3)

See footnotes at end of table.

World mine production of copper, 1940–46, in metric tons—Continued

Country	1940	1941	1942	1943	1944	1945	1946
Africa:							
Algeria	(3)	(3)	(3)	5	44	76	
Belgian Congo [8]	148,829	162,167	165,938	156,850	165,484	160,200	143,885
French Morocco	22	113	267	218	549	170	240
Northern Rhodesia [8]	266,605	231,917	250,564	255,027	224,397	197,192	185,472
South-West Africa	1,485	(3)	1,600	5,000	(3)		
Union of South Africa	14,335	20,738	24,583	22,731	22,869	24,016	26,980
	431,276	[4] 416,000	442,952	439,831	[4] 418,000	381,654	356,577
Australia	20,037	21,194	20,729	24,716	28,506	24,914	18,040
World total	2,416,916	2,564,887	[4]2,718,000	[4]2,715,000	[4]2,527,000	[4]2,150,000	[4]1,860,000

[1] Copper content of exports.
[2] United States imports.
[3] Data not available; estimate by authors of chapter included in total.
[4] Approximate production.
[5] January to June, inclusive.
[6] According to Yearbook of American Bureau of Metal Statistics.
[7] Output from U. S. S. R. in Asia included with U. S. S. R. in Europe.
[8] Smelter product.
[9] Data represent areas designated as Free China during the period of Japanese occupation.
[10] Preliminary data for fiscal year ended March 31 of year following that stated.
[11] April to September, inclusive.

World smelter production of copper, 1940–46, in metric tons

[Compiled by B. B. Mitchell]

Country	1940	1941	1942	1943	1944	1945	1946
North America:							
Canada	[1] 256,294	[1] 254,489	[1] 244,040	[1] 232,740	[1] 224,049	200,095	151,499
Mexico	31,252	40,914	44,729	43,013	32,974	53,287	52,371
United States [2]	922,364	1,015,346	1,111,458	1,103,918	1,022,382	784,173	592,229
Total	1,209,910	1,310,749	1,400,227	1,379,671	1,279,405	1,037,555	796,099
South America:							
Chile	336,861	453,594	477,733	489,320	489,906	440,289	358,603
Ecuador [3]				4,030	3,708	3,285	2,659
Peru	33,678	28,289	29,473	28,215	26,888	25,639	19,703
Total	370,539	481,883	507,206	521,565	520,502	469,213	380,965
Europe:							
Austria	2,136	2,517	2,761	5,711	6,051	1,454	
Belgium [4]	28,660	15,820	16,950	18,320	4,310		(5)
Finland	10,862	8,783	13,263	15,535	6,756	13,686	18,960
France [6]	932	659	407	404	122	6,213	9,696
Germany [7]	49,100	44,400	38,300	31,300	24,000	(5)	19,050
Italy	2,439	2,917	898	1,432			(5)
Norway	6,730	5,017	4,597	2,014	937	1,692	7,501
Rumania	25	124	46	70	(5)	(5)	(5)
Spain	9,422	8,900	11,590	10,952	10,891	6,268	8,147
Sweden	12,468	11,879	15,147	15,938	15,062	18,249	16,385
U. S. S. R. [7 8]	157,000	160,000	160,000	130,000	130,000	160,000	(5)
Yugoslavia	42,951	23,000	32,000	27,000	22,700	(5)	(5)
Total	322,725	284,016	295,959	258,676	220,900	[7] 248,000	(5)
Asia:							
China [9]	2,269	1,590	1,255	1,146	1,030	623	947
India	6,757	6,116	5,968	6,198	5,822	6,096	6,412
Japan [10]	105,295	100,526	102,062	119,858	102,352	26,871	(5)
Korea	3,206	3,806	4,330	4,554	5,193	[11] 426	[11] 161
Turkey	8,754	10,427	8,242	9,715	11,404	9,800	10,050
U. S. S. R.	(5)	(5)	(5)	(5)	(5)	(5)	(5)
Total	126,281	122,465	121,857	141,471	125,801	[7] 44,500	[7] 18,000

See footnotes at end of table.

World smelter production of copper, 1940–46, in metric tons—Continued

Country	1940	1941	1942	1943	1944	1945	1946
Africa:							
Belgian Congo	148,829	162,167	165,938	156,850	165,484	160,200	143,885
Northern Rhodesia	266,605	231,917	250,564	255,027	224,397	197,192	185,472
Union of South Africa	17,024	19,962	23,877	22,150	22,397	23,665	26,723
	432,458	414,046	440,379	434,027	412,278	381,057	356,080
Australia	18,432	22,016	25,004	20,785	20,217	20,827	19,140
World total	2,480,345	2,635,175	2,790,632	2,756,195	2,579,103	[7]2,200,000	[7]1,835,000

[1] Copper content of blister produced.
[2] Smelter output from domestic and foreign ores, exclusive of scrap. Production from domestic ores only, exclusive of scrap, was as follows: 1940, 824,703 tons; 1941, 876,401; 1942, 987,004; 1943, 991,492; 1944, 910,245; 1945, 710,073; 1946, 543,996. The diversion during the war of Belgian Congo matte from its previous destination, Belgium, for resmelting in the United States resulted in some duplication. The movement ended in 1945.
[3] United States imports.
[4] Figures represent blister copper only. Belgium reports a large output of refined copper which is not included above as it is believed produced principally from crude copper from Belgian Congo and would therefore duplicate output reported under the latter country.
[5] Data not available; estimate by authors of chapter included in total.
[6] Exclusive of material from scrap.
[7] Approximate production.
[8] Output from U. S. S. R in Asia included with U. S. S. R. in Europe.
[9] Data represent areas designated as Free China during the period of Japanese occupation.
[10] Preliminary data for fiscal year ended Mar. 31 of year following that stated.
[11] South Korea only.

Austria.—Chief copper deposits in Austria are at Mitterberg, Salzburg.[2] The only electrolytic refinery in Austria is at Brixlegg in the Tyrol. This plant has a reported capacity of 3,500 tons a year. Owing to heavy damages to equipment the plant did not operate in 1946 but was expected to resume in the spring of 1947.

Belgian Congo.—As was the case in the other chief copper-producing countries, output of copper declined in Belgian Congo in 1946. Except for Northern Rhodesia, where production fell only 6 percent, Belgian Congo's drop of 10 percent was the smallest decline among the main producers; 143,885 metric tons were produced in 1946 compared with 160,200 tons in 1945. The rate of output in the first half of the year, 13,000 tons, was only a little below the monthly average for 1945, but the rate in the latter half of the year was 18 percent less than the 1945 average. The drop in the second half of 1946 was due to shortages of hydraulic power and coal. Shipments of copper to Belgium, interrupted since 1940, were resumed in January 1945, according to information released at the annual meeting of Union Minière du Haut Katanga. The 1945 production, however, was sold chiefly to the United States Government. The British Government ceased purchases at the end of January 1945, when its contract terminated. Aggregate shipments to England in 5 war years exceeded 700,000 tons. At the end of 1945 all copper produced, as before the war, was going to Belgium and other European countries for direct delivery to buyers. Shipments to the United States ended in December 1945, although a quantity of unrefined copper, probably in transit at the year end, was recorded in United States imports for January, 1946. This series of reports has not previously reported the construction of a fire-refining plant at Lumbashi, Belgian Congo, completed in 1945. A series of

[2] Bureau of Mines, Mineral Trade Notes: Vol. 24, No. 5, May 1947, p. 5.

articles[3] describing the operations of Union Minière du Haut Katanga was published in 1945.

Belgium.—The February 4, 1947, issue of The Metal Bulletin (London) stated that the Oolen electrolytic copper refinery was working at virtually full capacity, using mainly Katanga blister. Capacity was said to be about 10,000 metric tons a month, and about 2,000 tons were reported scheduled to go to the British Ministry of Supply. At the annual meeting of the Société General Metallurgique de Hoboken it was reported that its Oolen plant had attained a normal rate of production, but that its Hoboken plant was operating at only a fraction of capacity because necessary crude materials for economic operation were unavailable.

Canada.—The year 1946 witnessed the smallest output of copper in Canada since 1934. The total was 22 percent less than in 1945 and 43 percent below the all-time peak in 1940; the decline has been uninterrupted since the peak year. The demand for nickel is a strong factor in determining the rate of copper production in Canada, inasmuch as the International Nickel Co. of Canada, Ltd., chief copper producer in the country, is the world's largest producer of nickel. The 1946 company report to stockholders stated that deliveries of nickel early in the year were curtailed by strikes in the major nickel-consuming industries. Zinc, gold, and silver are likewise important constituents in the ores of other large copper producers and play a part in determining the copper production of Canada. Producers in Canada continued to experience difficulties in obtaining a sufficient labor force in 1947 and also suffered from labor strikes, although to a much less extent than United States operators. Output in the last quarter of 1946 was little higher than in the first quarter, despite a marked gain at the International Nickel property, because of a strike at the property of Noranda Mines, Ltd.

The British Ministry of Supply contracted for most of Canada's exportable copper in 1946. According to reports[4] the Ministry purchased 140,000 short tons (said to be 75 percent of the exportable surplus) for 1947 delivery. The report stated that half of the tonnage was to be priced on the Engineering and Mining Journal daily average quotation for export copper f. a. s. Atlantic ports for the 6 calendar months prior to shipment. Of the remaining half, that part shipped in the first two quarters would be on the basis of 17.5 cents f. a. s. Atlantic ports, and agreement was to be reached subsequently regarding the remainder. Canadian manufacturers who use copper, lead, and zinc were favored by the price situation in Canada in 1946. By late November the controlled price for copper was about 6 cents under the "world" price of 17½ cents. Primary producers could export copper only after meeting domestic requirements. In November the Canadian Prices Board made arrangements whereby primary producers would participate in profits on manufactured metal articles sold in export markets. The official Canadian price for copper, delivered Toronto and Montreal, was increased from 11.5 cents a

[3] South African Mining and Engineering Jour., Union Minière du Haut Katanga, A Review of Its Mining Activities, Pt. I: Vol. 56, No. 2723, Apr. 21, 1945, p. 161.
How the Various Ores are Treated, Pt. II: Vol. 56, No. 2724, Apr. 28, 1945, p. 185.
Solving the Native Labour Problem, Pt. III: Vol. 56, No. 2725, May 5, 1945, p. 209.

[4] Metal Bulletin, No. 3148, Nov. 26, 1946, p. 4; and others.

pound to 16.625 cents on January 22, 1947. The United States export price at that time was 19.925 cents f. o. b. Atlantic seaboard refinery.

Copper produced (mine output) in Canada, 1942–46, by Provinces, in short tons

Province	1942	1943	1944	1945	1946 (preliminary)
British Columbia	25,008	21,111	18,152	12,876	10,359
Manitoba	23,798	19,008	21,939	20,563	20,000
Ontario	154,141	138,920	142,654	119,726	89,668
Quebec	70,456	65,582	54,027	51,342	35,016
Saskatchewan	28,391	42,974	36,757	32,950	30,500
Northwest Territories	37	----------	6	----------	----------
Total	301,831	287,595	273,535	237,457	185,543

More than half of Canada's copper production usually comes from the nickel-copper ores of the Sudbury district, Ontario, but in 1946 the proportion dropped to 48 percent. International Nickel, as already mentioned, was as usual the largest copper producer in Canada. Mining and smelting operations were at about 50 percent capacity in the first half of the year; they were increased in September and by the end of the year were up to 75 percent of the maximum wartime production. Copper sales totaled 74,889 short tons in 1946 compared with 107,862 tons in 1945 and 132,356 tons in 1944. Proved ore reserves at the year end stood at 217,142,000 short tons containing 6,861,000 tons of nickel-copper. Ore mined totaled 7,736,334 tons in 1946 compared with an annual average of 11,453,154 tons in 1943–45 and of 5,321,634 in 1936–38. The operations of the International Nickel Co., of Canada, Ltd., were described[5] in considerable detail in 1946. The Falconbridge Nickel Mines, Ltd., the other important producer in Ontario, hoisted 488,117 tons of ore and produced 2,845 tons of copper and 5,018 tons of nickel. Ore reserves were increased during the year and were estimated to be 8,296,500 tons containing 1.63 percent nickel and 0.85 percent copper at the year end.

Quebec as usual ranked second in production, copper coming from copper-gold, copper-zinc, and copper-pyrites ores in the western part of the Province. Noranda Mines, Ltd., is the outstanding producer in Quebec. A total of 953,437 tons of ore was hoisted at the Horne mine in 1946; 562,034 tons were milled, and 500,625 tons of ore and concentrates were smelted. The smelter treated 250,226 tons of custom material in addition. Copper output for the Horne mine was 13,763 tons of a total smelter output of 35,189 tons. In addition to copper, the Horne mine produced 155,197 ounces of gold and 317,997 ounces of silver. Developed ore reserves above the 2,975-foot level at the end of the year were 4,960,000 tons of sulfide ore averaging 7.14 percent copper, 14,692,000 tons of sulfide ore containing 0.67 percent copper, and some siliceous fluxing ore. Mining and smelting ceased on November 21 owing to a labor strike that continued into early 1947. The shortage of underground workmen reduced output of ore by Normetal Mining Corp., Ltd., to 511 tons a day, the smallest since 1940. At the end of 1946 ore reserves were

[5] Canadian Mining Journal, vol. 67, No. 5, May 1946, pp. 305–554.

estimated at 1,716,000 tons of ore, containing 3.68 percent copper and 7.28 percent zinc. Waite Amulet Mines, Ltd., treated 427,000 tons of ore in 1946 and at the end of the year had, with its subsidiary, 2,100,000 tons in reserve, compared with 2,500,000 at the end of 1945, no new ore having been discovered. Canadian Copper Refiners, Ltd., controlled by Noranda, produced 78,000 tons of copper in 1946.

The Hudson Bay Mining & Smelting Co., Ltd. (Flin Flon mine), and Sherritt Gordon Mines, Ltd., supply the copper output of Manitoba and Saskatchewan. A total of 1,837,472 tons of ore, averaging 2.39 percent copper and 5.0 percent zinc, was mined and milled at the Hudson Bay property. The smelter treated 387,477 tons of Hudson Bay concentrate and ore and 45,565 tons of custom concentrates. Production of refined metals for company account included 39,792 tons of copper, 141,486 ounces of gold, and 1,823,210 ounces of silver. At the Sherritt Gordon Mines, Ltd., property 558,836 tons of ore were milled (646,092 tons in 1945) and 10,774 tons of copper, 6,185 ounces of gold, 196,545 ounces of silver, and 17,291 tons of zinc concentrate produced. Exhaustion of the mine at Sherridon was reported by the company to be near, the East mine out of ore by the end of the year, and the West ore body down to 1,368,000 tons, averaging 2.60 percent copper and 2.12 percent zinc. Production of ore totaled 558,836 tons and of copper 10,774 tons in 1946. A total of 74,798 feet of diamond drilling was done on the company's nickel-copper property at Lynn Lake, 120 miles north of Sherridon. This ore body was estimated to contain 4,974,000 tons of ore, averaging 1.18 percent nickel and 0.60 percent copper, above the 1,000-foot level. Sherridon equipment will be moved to Lynn Lake as exhaustion of the West mine is reached and as required for equipping the new property.

Chief producers of copper in British Columbia are the Granby Consolidated Mining, Smelting & Power Co., Ltd., and Britannia Mining & Smelting Co., Ltd.

Exports in 1946 (comparison with 1945 in parentheses) were 101,414 (129,349) short tons of copper ingots, bars, and billets, 15,916 (7,281) tons of rods, strips, sheet, and tubing, 17,628 (19,295) tons of copper in ores, matte, regulus, etc., and 1,230 (1,438) tons of copper, old and scrap.

Chile.—Mine production of copper dropped 19 percent in 1946, from 446,398 metric tons in 1945 to 360,935 tons, and was the smallest since 1940. A 5-week labor strike at the Chuquicamata mine of the Chile Exploration Co., ending late in June, and one at the Braden mine of the Kennecott Copper Corp., beginning late in September and settled in December, were the principal deterrents to capacity operations, but other strikes lasting a few days each and a serious shortage of water at Braden were added adverse factors. The Kennecott Copper Corp. commented on the situation as follows:

* * * The new government which came into office on November 3 directed such great pressure against the company that it finally agreed to the arbitration of a number of points involved in the dispute. Production was resumed on December 11. The Arbiter's award, handed down on December 27, granted wage increases, additional vacation allowances, and certain changes in working regulations. As a result of the award and the agreements made earlier with the unions at the smelter, power plants and shops, wages at the end of December were approximately 22 percent higher than in June.

Loss of copper production from this prolonged strike and several others of a few days' duration was augmented by an acute water shortage resulting from a subnormal snowfall in 1945 followed by practically no snow at all during the Chilean winter of 1946. This unusual weather condition reduced the water available for hydro-electric power and concentrator operations throughout the year and will likewise adversely affect output in the first half of 1947. As compared with 1945, there was a decrease of 3,308,888 tons in the ore milled, the 1946 figure being 5,384,408 tons assaying 2.133 percent copper. Smelter production totaled 187,449,600 pounds, a decrease of 142,348,478 from that of the previous year. * * *

The Chuquicamata mine of the Chile Exploration Co. and the Andes mine of the Andes Copper Mining Co., subsidiaries of the Anaconda Copper Mining Co., produced 231,926 short (210,399 metric) and 69,509 (63,057 metric) tons, respectively, in 1946, decreases from 261,929 (237,617 metric) and 70,311 (63,785 metric) tons, respectively, in 1945.

The custom smelters at Chagres and Natalga were closed during the entire year, and very little production was contributed by small mines following cancellation of the United States Commercial Co. contracts in 1945.

Exports of the chief copper classes, by countries, are shown below in metric tons:

	Electrolytic	*Standard (furnace refined)*
United States	80, 812	88, 430
Great Britain	46, 363	23, 772
France	27, 986	9, 449
Italy	24, 967	8, 297
Sweden	17, 630	1, 600
Argentina	9, 066	------
Brazil	7, 649	3, 250
Netherlands	6, 601	------
India	5, 331	------
Poland	2, 720	------
Czechoslovakia	2, 267	------
Switzerland	1, 954	2, 647
Morocco	1, 798	------
Belgium	354	------
China	219	------
Norway	101	101
Bolivia	27	------
Uruguay	-------	430
Colombia	-------	190
Total	235, 845	138, 166

Exports of concentrates in 1946 were 3,367 tons, all of which went to the United States.

Finland.—The report of this series for 1945 pointed out that the capacity of the Outokumpu Copper Co. was recently enlarged by the construction of a modern smelting works at Harjavalta. Owing to the fact that the 12,000-ton smelter at Imatra was within range of artillery fire, it was shut at the beginning of July 1944.[6] All loose machinery was moved westward to Harjavalta and the capacity of the new plant increased to 24,000 tons. First copper was poured January 7, 1945, 5 months after the beginning of the construction, in smelter buildings without walls or roof and during freezing weather.

[6] Bryk, P., Levanto, K. I., Makinen, Eero, and Ryselin, John, Outokumpu's Copper Smelter Doubles Output During War: Eng. and Min. Jour., vol. 148, No. 1, January 1947, pp. 68–72.

The discovery of the Outokumpu ore in 1910 and the development of the property to a completely integrated concern with electrolytic copper and nickel refineries, rolling mill, and plant for the manufacture of tubes, rods, and profiles are described in the article cited. Ore reserves were said to be 17,000,000 tons averaging 3.5 percent copper. Ore reserves of the Ylojarvi mine, discovered in 1937 and also under ownership of the Outokumpu Co., were said not yet to be well-defined, but were estimated at 800,000 tons averaging 1 percent copper.

Germany.—The war operation of German smelting and refining plants is indicated in the following tables.

Smelter production of copper in Germany from ore, 1940–44 (yearly average)

Occupation zone and plant	Metric tons [1]
American:	
Kurhessische Kupferschieferbergbau, Richelsdorf, Sontra (Kreis Rotenburg) [2]	3,000
British:	
Norddeutsche Affinerie, Hamburg	16,500
Kupferhütte Ertel, Bieber & Co., Hamburg	1,000
Hochofenwerk Lübeck, Herrenwyk	[3] 1,500
Unterharzer Berg- und Hüttenwerke, Oker	1,000
Kupferbergbau Niedermarsberg, Niedermarsberg	700
Duisburger Kupferhütte, Duisburg	2,500
Total British	23,200
Russian:	
Mansfeldscher Kupferschieferbergbau A. G., Eisleben	18,000
Mansfeldscher Kupferschieferbergbau A. G., Hettstedt	
Mansfeldscher Kupferschieferbergbau A. G., Helbra	
Hochofenwerk Lübeck A. G., Kratzwieck	([3])
Metallhütte, Magdeburg	----------
Total Russian	18,000
Total Germany	41,200

[1] Partly estimated.
[2] Production of copper matte, which is included also in the figures of Mansfeld.
[3] Data for plant at Kratzwieck (Russian zone) included with plant at Herrenwyk (British zone).

Refinery production of copper in Germany, 1940–44 (yearly average)

Occupation zone and plant	Metric tons [1]	
	Electrolytic	Fire refined
British:		
Hochofenwerk Lübeck A. G., Herrenwyk	3,000	----------
Norddeutsche Affinerie, Hamburg	71,000	500
Zinnwerke Wilhelmsburg G. m. b. H., Hamburg-Wilhelmsburg	[2] 12,000	[2] 800
Unterharzer Berg- und Hüttenwerke, Oker	2,000	----------
Kupferbergbau Niedermarsberg, Niedermarsberg/Westf.	----------	----------
Hüttenwerke Kayser A. G., Lünen	[2] 15,000	([2])
Metallhütte Kall, Kall/Eifel	----------	----------
Total British	103,000	1,300
Russian:		
Hüttenwerke Kayser A. G., Oranienburg	[2] 20,000	([2])
Hüttenwerke Kayser A. G., Niederschöneweide		
Kupferwerk Ilsenburg A. G., Ilsenburg/Harz	5,000	3,000
Mansfelder Kupferschieferbergbau A. G., Hettstedt	[2] 30,000	[2] 3,700
Staatl. Hütten- u. Blaufarbenwerke, Freiberg/Sa.	300	----------
Hüttenwerke Tempelhof A. Meyer, Berlin	----------	----------
Metallhütte, Berlin-Lichtenberg	----------	----------
Total Russian	55,300	6,700
Total Germany	158,300	8,000

[1] Partly estimated.
[2] Production of electrolytic copper includes some fire-refined copper delivered in electrolytic quality.

A long list of German nonferrous smelters and refineries were declared by the Allied occupation authorities as available for reparations. The following copper plants were listed as surplus to the authorized industrial level and available for reparation or destruction:

Norddeutsche Affinerie, Hamburg:
Producer of electrolytic copper, lead, tin, nickel, bismuth, silver, gold, metallic powders, sulphate of copper, and arsenic. Annual capacity (tons): Copper, 90,000; lead, 12,000; nickel, 400; bismuth, 120.
(NOTE.—Copper smelter—capacity 40,000 tons—is to be retained.)
Zinnewerke Wilhelmsburg, Hamburg:
Copper and tin smelter. Capacity (tons): Copper, 48,000 annually; tin and byproducts 14,400.
Kupferhutte Ertel Bieber, Hamburg:
Copper precipitate, zinc oxide, iron concentrates. Annual capacity (tons): Copper precipitate, 2,000; zinc oxide, 2,000; iron concentrates, 100,000.
Metallhutte Kall, G. m. b. H., Kall (Eifel):
Copper, copper oxides, copper alloys. Capacity (tons): Copper, 6,000; oxides, 4,000; alloys, 4,800.

Of the 85 nonferrous metal smelting, refining, and fabricating plants shown in a subsequent report,[7] 26 listed copper as principal or subsidiary product, and 12 additional ones listed nonferrous materials without specification.

Many reports describing Germany's industrial plants and processes have been issued, a number [8] of which relate to copper mining, reduction, or fabrication.

Northern Rhodesia.—Production of copper was affected adversely by labor problems and inadequate supplies of coal, but the total for 1946 was only 6 percent below that for 1945 although 30 percent less than the all-time peak in 1940. The four big copper producers in Northern Rhodesia—Mufulira, Nchanga, Rhokana, and Roan Antelope—were closed for more than a month during 1946 by a strike of skilled workers beginning July 15. The union agreed to accept arbitration and the strikers returned to work August 21, but it was the end of October before arbitration proceedings were completed. Inadequate rail facilities led to coal shortages from time to time during the year and further restricted copper production. Rhodesian production for 1946 was contracted largely to the British Ministry of Supply. A significant event during 1946 was the formation of a company to take over and expand Rhodesian refining facilities. The Rhodesia Copper Refineries, Ltd., was formed by Rhokana Corp., Ltd., and Nchanga Consolidated Copper Mines, Ltd., in the latter

[7] Foreign Commerce Weekly, Reparations Developments: Vol. 25, No. 2, Oct. 12, 1946, pp. 40–41.
[8] British Intelligence Objectives Subcommittee Final Reports:
Mannox, F. C. and Miller, H. J., Copper Smelting and Refining, Together With Related Metallurgical Activities at Nord Deutsche Affinerie, Hamburg: No. 26, July–August 1945, 21 pp.
Sykes, J., German Brass and Copper Wire: No. 264, Aug. 1, 1946, 21 pp.
Myers, H. M., and others, Rolled Nonferrous Metals Industries in Germany: No. 402, December 1945, 94 pp.
Davey, C. F., and others, Manufacture of Sulfate of Copper in Germany: No. 448, undated, 7 pp.
Stewart, D. A., Copper and Copper Base Alloy Tube Manufacture in Germany: No. 495, December 1945, 52 pp.
Levy, S. I., Extraction of Copper and Other Metals From Pyrites Cinder: No. 496, March 1946, 24 pp.
Office of Military Government for Germany (US) Fiat Final Reports (published by U. S. Department of Commerce):
Phillips, Albert J., Copper, Lead, Zinc, Tin and Antimony Smelting and Refining in Northwestern Germany: No. 229, Oct. 2, 1945, 47 pp.
Rouse, Edwin W., Nonferrous Metal Rolling Mill Practice in Germany: No. 406, Jan. 2, 1946, 30 pp.
Aitkenhead, William C., Nonferrous Metal Production Processes in the Hamburg District: No. 829, June 13, 1946, 25 pp.
Combined Intelligence Objectives Subcommittee item:
Hall, Herbert H. and Kemp, James T., Mansfeldscher Kupperschieferbergbau, A. G., Eisleben, Germany: Item 21, June 24–25, 1945, 10 pp.

part of the year to purchase the refinery at Nkana from Rhokana and arrange to duplicate the plant immediately. The proposed extension will permit the refining of the entire estimated output of the forming companies up to the end of 1951. A further extension may be needed to refine the increased output from the Nchanga mine to become effective about 1952. The projected doubling of the plant would result in a refinery capacity of close to 140,000 short tons of electrolytic copper a year.

At the Roan Antelope mine 2,624,900 short tons of ore containing 2.59 percent copper were mined in the fiscal year ended June 30, 1946, or almost exactly the same as in the preceding 12 months. Ore reserves at the end of June were estimated as 100,316,041 tons averaging 3.28 percent copper. Ore handling at Roan Antelope was recently described.[9]

The Rhokana Corp., Ltd., produced 99,250 short tons of copper in the fiscal year ended June 30, 1946, compared with 107,597 tons in 1945. Of the 1946 total, 10,618 tons were Nkana blister, 21,784 tons were Nchanga blister, and 66,848 tons were Nkana electrolytic, compared with 20,001, 17,976, and 69,620 tons, respectively, in 1945. Ore reserves at the end of June 1946 totaled in the Nkana north ore body 23,957,700 short tons containing 3.34 percent copper, in the Nkana south ore body 20,165,000 tons containing 2.78 percent copper, and in the Mindola ore body 58,272,900 tons containing 3.68 percent copper.

The Nchanga Consolidated Copper Co. mined 561,084 short tons in the fiscal year ended March 31, 1946, and milled 558,300 tons containing 4.59 percent copper, of which 2.29 percent was in the form of oxide and 2.30 percent in the form of sulfide. Production capacity was raised to 30,000 short tons April 1, 1946. Sulfide concentrates will continue to be treated by Rhokana, and the carbonate concentrates will be treated in a backing plant to be built at Nchanga. Ore reserves were estimated as 141,117,000 tons.

Mufulira Copper Mines produced 56,045 short tons of copper in the fiscal year ended June 30, 1946, compared with 65,268 tons in the preceding year. Total ore reserves were 136,557,000 tons averaging 3.83 percent copper compared with an annual milling rate of less than 2,000,000 tons.

United Kingdom.—The United Kingdom easily ranked as the second-most important copper-consuming country in the world again in 1946. Figures released by the British Non-Ferrous Metals Federation indicate that 493,716 long tons of copper were consumed in 1946, of which 325,409 tons were virgin metal and 168,307 tons copper contained in scrap. These figures compare with 461,531, 288,613, and 172,918 tons, respectively, in 1945. Stocks of virgin metal were 92,300 tons at the end of 1946 compared with 123,100 tons at the beginning of the year.

The British Ministry of Supply continued bulk purchasing in 1946, taking preponderant shares of the copper exported from Northern Rhodesia and Canada, as well as smaller proportions from Belgian

[9] Goldick, M. R., Ore Handling at Roan Antelope: Mining Mag., vol. 74, No. 4, April 1946, pp. 209–214.

Congo, Chile, and other countries. Imports of the important copper classes in 1946, in long tons, were as follows:

Source:	*Electrolytic*	*Standard*
Northern Rhodesia	25, 950	98, 878
Canada	60, 415	(1)
Belgian Congo	[2] 28, 117	(1)
United States	3, 524	(1)
Other countries [3]	50, 777	23, 482
	168, 783	122, 360

[1] Not separately reported; if any, included with "Other countries."
[2] Apparently by reshipment; see discussions under Belgian Congo and Belgium.
[3] Apparently principally Chile.

The gross weight of copper ore imported was 13,004 tons. Exports in 1946 were as follows:

	Long tons
Copper ingots, etc	19, 221
Plates, sheets, etc	16, 938
Wire in coils	24, 622
Tubes	4, 606
Other manufactures	7, 988
Total	73, 375

Copper ingots aggregating 6,066 tons were reexported.

Copper sulfate production in 1946 amounted to 55,200 long tons containing 13,801 tons of copper.

Feldspar

By ROBERT W. METCALF AND A. B. HOLLEMAN

GENERAL SUMMARY

RECORD outputs of plate glass and glass containers and large increases in the demand for pottery and enamel products stimulated the feldspar industry in 1946 to new peaks in production for both crude and ground spar. The output of crude feldspar rose 36 percent in quantity and 28 percent in value and the output of ground spar increased 23 percent in tonnage and 26 percent in value compared with 1945, the former record year for both crude and ground material. Crude feldspar topped one-half million tons for the first time in history. Production of aplite also increased sharply to a new record output. Imports of Canadian crude feldspar increased 10 percent and were the highest since 1930. Receipts of crude nepheline syenite (all from Canada) again were higher than in any previous year.

Production of crude feldspar in all States reporting output in 1946 was higher than in 1945. North Carolina broke its previous record year—1945—by 55 percent. Virginia increased its output of crude spar by 13 percent. Large gains in production were shown in the New England States. Output in South Dakota—the second highest producing State—Wyoming, and Colorado in 1946 were 9, 20, and 42 percent, respectively, higher than in 1945. Ground feldspar sold from

Salient statistics of the feldspar industry in the United States, 1925–29 (average), 1935–39 (average), 1940–44 (average), and 1945–46

	1925–29 (average)	1935–39 (average)	1940–44 (average)	1945	1946
Crude feldspar:					
Domestic sales:					
Long tons	201,340	230,479	316,275	373,054	508,380
Value	$1,408,625	$1,139,860	$1,559,673	$2,021,529	$2,594,099
Average per long ton	$7.00	$4.95	$4.93	$5.42	$5.10
Imports:					
Long tons	28,029	9,558	11,149	14,924	16,365
Value	$225,810	$64,905	$80,467	$114,917	$127,654
Average per long ton	$8.06	$6.79	$7.22	$7.70	$7.80
Ground feldspar:					
Sales by merchant mills:					
Short tons	224,075	237,993	329,385	381,728	470,199
Value	$3,539,813	$2,925,853	$3,565,610	$4,246,961	$5,346,107
Average per short ton	$15.80	$12.29	$10.83	$11.13	$11.37
Imports:					
Short tons	20	27	10	----------	(1)
Value	$594	$287	$124	----------	$2.00
Average per short ton	$29.98	$10.64	$12.16	----------	----------

[1] Less than 1 ton.

North Carolina and Tennessee mills in 1946 was 46 percent greater than in 1945. Sales of ground spar from Virginia showed a moderate increase. Output in New Jersey and Connecticut combined in 1946 was about one-sixth greater than in 1945. Arizona, Colorado, Maine, and New York showed large percentage gains over 1945. Feldspar ground in South Dakota and Tennessee in 1946, however, was less than that reported in 1945.

The greatly increased output of feldspar in 1946 was directly traceable to the higher level of industrial activity in that year, particularly in the ceramic industries. This is borne out by the 61-percent increase of active ceramic plants (those manufacturing pottery, porcelain enamel, glass, brick, and other ceramic products) over a period extending from December 1943 to June 1946, reported by the Department of Commerce.[1] Most of this expansion took place after the war.

With respect to individual segments of the ceramic field in which large quantities of feldspar are consumed, the production of glass containers in 1946 reached an all-time high of 116 million gross, or 10 percent higher than in 1945. Inventories of glass containers dropped 17 percent during 1946. Plate-glass output in 1946 also surpassed all previous records, totaling 210,006,188 square feet or 6 percent more than in 1936, the former high year, and more than double 1944's production. Manufacturers' sales of machine-made table, kitchen, and household glassware increased 46 percent compared with 1945, and both production and shipments of automatic tumblers were substantially higher in 1946 than in 1945. The higher level of residential and industrial construction resulted in a 66-percent gain in output of floor and wall tile in 1946 [2] and was chiefly responsible for the large gain in shipments of porcelain enameled products. Assuming no major recession, the outlook for a continued active market for feldspar seems favorable. The growing use of improved methods of beneficiation, such as froth flotation, is increasing the ability of the industry to satisfy all demands.

DOMESTIC PRODUCTION

Following the usual practice in the industry, crude feldspar is reported in long tons of 2,240 pounds and ground feldspar in short (net) tons of 2,000 pounds.

CRUDE FELDSPAR

Output of crude feldspar in 1946 again broke all existing production records in both quantity and value, surpassing the former high year —1945—by 36 percent in quantity and 28 percent in value. Production in 1946 topped 500,000 long tons for the first time, reaching 508,380 tons valued at $2,594,099, compared with 373,054 tons valued at $2,021,529 in 1945.

Output in all important producing States registered moderate to large gains in tonnage in 1946. The increases were especially pronounced in North Carolina and New England.

[1] Ceramic Industry, vol. 48, No. 3, March 1947, p. 47.
[2] Work cited in footnote 1, p. 55.

Crude feldspar sold or used by producers in the United States, 1942–46

Year	Long tons	Value		Year	Long tons	Value	
		Total	Average			Total	Average
1942	316,166	$1,546,702	$4.89	1945	373,054	$2,021,529	$5.42
1943	308,180	1,646,277	5.34	1946	508,380	2,594,099	5.10
1944	327,408	1,813,937	5.54				

Crude feldspar was produced in 1946 in 12 States, 1 less than in 1945. No output was reported in 1946 from California and Pennsylvania, while production in Georgia appeared for the first time since 1916. Output in North Carolina eclipsed the previous record year (1945) by 55 percent in tonnage and 39 percent in value, rising in 1946 to 230,367 long tons valued at $1,200,638. Production in Virginia rose 13 percent. Output in Maine increased 72 percent to the highest point since 1941; in New Hampshire, 30 percent more feldspar was mined in 1946 than in 1945; and production in Connecticut rose 41 percent to the highest level since 1940. South Dakota, with the second largest production, increased its output in 1946 by 9 percent compared with 1945, and Colorado's output rose 42 percent. Crude spar mined in Wyoming, which markets virtually all its tonnage to mills in Colorado, was 20 percent greater than in 1945. Tonnages increased moderately in Arizona, New York, and Texas.

Crude feldspar sold or used by producers in the United States, 1944–46, by States

State	1944		1945		1946	
	Long tons	Value	Long tons	Value	Long tons	Value
Colorado	15,787	$81,967	26,279	$105,021	37,312	$145,975
Connecticut	11,390	75,394	11,705	74,778	16,555	98,407
Maine	8,011	47,892	10,974	62,287	18,922	110,237
North Carolina	122,857	778,007	148,493	863,740	230,367	1,200,638
South Dakota	64,806	288,188	68,374	314,787	74,540	299,852
Virginia	24,010	147,106	29,089	178,664	32,960	204,588
Wyoming	22,415	81,770	17,021	62,614	20,345	83,496
Undistributed [1]	58,132	313,613	61,119	359,638	77,379	450,906
	327,408	1,813,937	373,054	2,021,529	508,380	2,594,099

[1] Includes Arizona, New Hampshire, New York, and Texas; and, in addition, California and Pennsylvania in 1944–45 and Georgia in 1946.

Studies of mineral resources and potential investment opportunities in Colorado [3] and North Carolina,[4] including references to feldspar deposits, were published.

GROUND FELDSPAR

Sales of ground feldspar by merchant mills in 1946 topped the former peak year 1945 by 23 percent in quantity and 26 percent in value, totaling 470,199 short tons valued at $5,346,107. Production in

[3] Prommel, H. W. C., Colorado's Potential Mineral Resources: Mines Mag., vol. 36, No. 6, June 1946, pp. 241–244, 276–277. Chem. Abs., vol. 40, No. 20, Oct. 20, 1946, p. 6188.

[4] Greaves-Walker, A. F., Investment Opportunities in North Carolina Minerals: North Carolina State Coll. Eng. Exper. Sta. Bull. 31, November 1945, 29 pp. Jour. Am. Ceram. Soc., vol. 29, No. 10, Oct. 1, 1946, p. 181.

California, South Dakota, and Tennessee was somewhat less in 1946 than in 1945; in all other States, however, increases were reported. North Carolina and Tennessee mills combined supplied 44 percent of the total sales of feldspar ground in the United States in 1946 compared with 37 percent in 1945 and 26 percent in 1942. Sales of feldspar of Canadian origin ground in merchant mills in the United States in 1946 were 64 percent greater than in 1945 but comprised only 3 percent of the total merchant sales. In addition, relatively small tonnages of Canadian origin are ground by consumers, principally pottery and cleanser manufacturers, who import their spar direct and whose figures are not included in these compilations.

Ground feldspar sold by merchant mills [1] in the United States, 1942–46

Year	Active mills	Domestic			Canadian			Total	
		Short tons	Value		Short tons	Value		Short tons	Value
			Total	Average		Total	Average		
1942	29	318,209	$3,339,462	$10.49	9,577	$185,507	$19.37	327,786	$3,524,969
1943	27	329,354	3,465,885	10.52	6,456	126,075	19.53	335,810	3,591,960
1944	28	335,491	3,714,039	11.07	7,710	148,997	19.33	343,201	3,863,036
1945	30	372,377	4,062,077	10.91	9,351	184,884	19.77	381,728	4,246,961
1946	28	454,869	5,029,330	11.06	15,330	316,777	20.66	470,199	5,346,107

[1] Excludes potters and others who grind for consumption in their own plants.

North Carolina in 1946 was by far the largest producer of ground feldspar, followed by South Dakota, Colorado, Tennessee, and New Hampshire. Ground spar produced in North Carolina and Tennessee combined in 1946 increased to 207,527 short tons—a new record. Output in New Jersey and Connecticut combined was 17 percent higher than in 1945; in Maine, 52 percent higher; and in Colorado, 33 percent higher. Most other producing States showed large percentage gains in 1946 compared with 1945.

Colorado Feldspar Co., formerly a subsidiary and now an integral part of Consolidated Feldspar Corp., Trenton, N. J., plans to erect

Ground feldspar sold by merchant mills [1] in the United States, 1944–46, by States

State	1944			1945			1946		
	Active mills	Short tons	Value	Active mills	Short tons	Value	Active mills	Short tons	Value
California	3	1,188	$17,688	3	809	$11,911	2	294	$5,276
Colorado	3	45,365	318,696	3	41,433	307,619	2	55,251	448,011
Connecticut	1	22,079	409,875	2	19,139	355,578	2	22,464	405,828
New Jersey	3			2			2		
Maine	2	11,184	178,049	2	9,746	156,618	3	14,822	235,636
North Carolina	3	110,251	1,326,861	4	142,208	1,665,634	4	207,527	2,194,552
Tennessee	2			2			2		
Undistributed [2]	11	153,134	1,611,867	12	168,393	1,749,601	11	169,841	2,056,804
	28	343,201	3,863,036	30	381,728	4,246,961	28	470,199	5,346,107

[1] Excludes potters and others who grind for consumption in their own plants.
[2] Includes (number of active mills in parentheses) Arizona (1), Illinois (1), New Hampshire (2 in 1944 and 1946, 3 in 1945), New York (3), South Dakota (2), and Virginia (2).

a $150,000 feldspar-processing mill at Parkdale, Fremont County, Colo., about 12 miles west of Canon City.[5] Grinding was scheduled to begin in the early part of 1947.

CONSUMPTION AND USES

Crude Feldspar.—Although a number of grinders mine their own feldspar, either themselves or through affiliated firms, most crude feldspar is mined by small operators and sold to merchant mills. Several mines or localities may contribute to their raw-material supply. The spar received by the mills, whether purchased or mined, is stock-piled according to grade and source, blended to obtain a desired composition in the finished product, ground to specified fineness, perhaps refined in magnetic separators, and sold to ultimate consumers. An increasing tonnage of feldspar or feldspar-containing rocks is being treated in flotation machines.

A few pottery and enamel manufacturers purchase as crude spar part or all the feldspar they require and grind it in their own mills. Certain makers of soap, cleansers, and sweeping compounds also mine or purchase crude feldspar, and after grinding or otherwise processing it utilize the spar in their products. Some Canadian crude feldspar is purchased direct by consumers in this country. Manufacturers of artificial teeth annually consume a small tonnage of very carefully selected crude material, which must be free from all grit and is sold at a considerable premium over No. 1 grade commercial feldspar.

Ground Feldspar.—Ceramic industries in 1945 and 1946 consumed 99 percent of the ground feldspar sold by merchant mills. Sales of ground spar to the glass industry in 1946 totaled 289,559 short tons, a new record, 16 percent above the former high reported in 1945. Sales to potteries were also the largest yet recorded—154,340 tons, or 38 percent higher than in 1945 and 21 percent greater than in the previous peak year 1941. Ground feldspar consumed in enamel manufacture in 1946 rose 64 percent compared with 1945 but was considerably under the 1941 level. Ground spar sold by merchant grinders for use in soaps, cleansers, and abrasives was 27 percent less in 1946 than in 1945. The remainder of the ground feldspar was consumed in miscellaneous ceramic applications.

Ground feldspar sold by merchant mills in the United States, 1944–46

Use	1944		1945		1946	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Ceramic:						
Glass	220,734	64.3	249,927	65.5	289,559	61.6
Pottery	106,341	31.0	111,695	29.3	154,340	32.8
Enamel	8,464	2.5	13,755	3.6	22,500	4.8
Other ceramic uses	849	.2	1,747	.4	144	
Soaps and abrasives	6,424	1.9	4,245	1.1	3,081	.7
Other uses	389	.1	359	.1	575	.1
	343,201	100.0	381,728	100.0	470,199	100.0

[5] Engineering and Mining Journal, vol. 147, No. 7, July 1946, p. 114.

Ground feldspar shipped from merchant mills in the United States, 1942–46, by destinations, in short tons

Destination	1942	1943	1944	1945	1946
California	12,224	8,669	9,788	8,735	8,641
Illinois	50,450	49,302	49,434	53,114	68,737
Indiana	38,998	40,873	40,057	47,321	47,756
Maryland	8,745	9,028	7,593	9,411	18,374
Massachusetts	3,630	3,855	3,508	3,258	3,009
New Jersey	43,029	40,259	38,158	35,735	41,340
New York	18,363	18,024	21,886	19,005	19,420
Ohio	43,950	42,536	41,208	48,151	47,031
Oklahoma	8,002	(1)	(1)	(1)	14,411
Pennsylvania	40,013	36,190	47,803	47,217	70,706
Tennessee	3,507	2,677	4,983	8,881	18,337
West Virginia	35,161	48,940	45,658	58,653	66,024
Wisconsin	7,837	8,718	7,993	7,058	10,317
Other destinations [2]	13,877	26,739	25,132	35,189	36,096
	327,786	335,810	343,201	381,728	470,199

[1] Included under "Other destinations"; separate figure for State not available.
[2] Includes Arkansas, Colorado, Connecticut, District of Columbia, Hawaii, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Oklahoma (1943–45), Puerto Rico, Rhode Island, South Carolina, Texas, and States receiving shipments that cannot be segregated; also small shipments to Belgium, Canada, England, and Mexico.

The application and use of feldspar in glazes [6] and in porcelain enamels [7] were reported.

Descriptions, characteristics and varieties of feldspar used as gems were reported by Pough.[8] Another account of the employment of feldspar as gem material was included in a compilation of data on birthstones.[9]

PRICES

Quotations on crude feldspar do not appear in the trade press. Average realizations by States, however, have been computed from the data reported to the Bureau of Mines each year by the operators. According to these returns, the average realization per long ton for crude spar in 1946 decreased 6 percent to $5.10 compared with $5.42 in 1945. Except for the preceding 3 years (1943–45), this was the highest realization since 1937. Increases in average value occurred in Virginia (1 percent), Maine (3 percent), and Wyoming (11 percent). All other States showed small to moderate decreases in realization. Averages per ton for certain States in 1945 and 1946 (1945 in parentheses) follow: North Carolina, $5.21 ($5.82); Virginia, $6.21 ($6.14); Maine, $5.83 ($5.68); Connecticut, $5.94 ($6.39); Colorado, $3.91 ($4); South Dakota, $4.02 ($4.60); and Wyoming, $4.10 ($3.68).

The average realization per short ton for ground feldspar rose to $11.37 in 1946 compared with $11.13 in 1945 and was the highest since 1938 ($11.50). The average value per ton in North Carolina-Tennessee declined 10 percent compared with the 1945 values, probably due to the greater proportion of glass spar marketed. In Maine and Connecticut-New Jersey the average value decreased

[6] Thiess, L. E., Steatite Glazes: Jour. Am. Ceram. Soc., vol. 29, No. 3, Mar. 1, 1946, pp. 84–86. Jenkins, R. Horace, Glazes and Glaze Formulas: Ceram. Age, vol. 48, No. 4, 1946, pp. 160, 162–163; Jour. Am. Ceram. Soc., vol. 30, No. 2, Feb. 1, 1947, p. 34.
[7] Murdock, A. W., Classification and Properties of Porcelain Enamels (I, II): Enamelist, vol. 22, No. 12, 1946, pp. 19–26; No. 13, 1946, pp. 25–30.
[8] Pough, Frederick H., Little Known Gemstones—Feldspar: Jewelers' Circ.—Keystone, vol. 117, No. 3, December 1946, pp. 222, 275–277.
[9] Jewelers' Circular—Keystone, Gem of the Month—Merchandising Primer: Vol. 117, No. 4, January 1947, pp. 224, 276–280.

slightly. On the other hand, in Arizona, Colorado, South Dakota, and Virginia it rose 9 to 20 percent. Realizations per short ton for individual States ranged from $8.11 to $18.07. Average values for ground spar for selected States in 1946 follow: Colorado, $8.11; South Dakota, $9.58; North Carolina-Tennessee, $10.57; New Hampshire, $12.37; Maine, $15.90; and Connecticut-New Jersey, $18.07.

According to E&MJ Metal and Mineral Markets, prices of ground feldspar in 1946 were quoted at the same figures as in 1945 and immediately preceding years. Potash and soda feldspars, in bulk, f. o. b. North Carolina or Maine, 200-mesh, white, were listed at $17 and $19, respectively. Granular glass spar, f. o. b. North Carolina, 20-mesh, white, in bulk, was quoted at $12.50 per ton and semigranular glass spar at $11.75. Quotations on Virginia feldspar were: No. 1, 230-mesh, $18; 200-mesh, $17; glassmakers' spar No. 18, $12.50; and No. 17, $11.75. Ground feldspar for enamelers' use ranged from $14 to $16 per ton, f. o. b., on either a Spruce Pine, N. C., or Keene, N. H., basis.

FOREIGN TRADE [10]

Feldspar.—Crude feldspar imported for consumption in the United States in 1946 totaled 16,365 long tons valued at $127,654—10 and 11 percent larger in quantity and value, respectively, than in 1945 and the highest level of imports since 1930. All of the imports of crude spar originated in Canada, except for 2 tons from the United Kingdom. Imports of ground feldspar during the last few years have been very small.

Feldspar imported for consumption in the United States, 1942–46

Year	Crude		Ground		Year	Crude		Ground	
	Long tons	Value	Short tons	Value		Long tons	Value	Short tons	Value
1942	9,525	$69,798			1945	14,924	$114,917		
1943	10,758	83,073	41	$417	1946	16,365	127,654	(1)	$2
1944	11,686	95,956	10	203					

[1] Less than 1 ton.

Cornwall Stone.—Imports for consumption of unmanufactured Cornwall stone in 1946 totaled 456 long tons valued at $6,031. Imports of both unmanufactured and ground Cornwall stone have originated in United Kingdom.

Cornwall stone imported for consumption in the United States, 1942–46

Year	Unmanufactured		Ground		Year	Unmanufactured		Ground	
	Long tons	Value	Long tons	Value		Long tons	Value	Long tons	Value
1942	74	$1,021	5	$92	1945	838	$11,317		
1943	392	5,591	20	442	1946	456	6,031	80	$1,806
1944	463	6,394	10	225					

[10] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

NEPHELINE SYENITE

Nepheline syenite is a quartz-free crystalline rock consisting principally of nephelite (an alumina-potash-soda silicate) and albite and microcline feldspars. Often associated are the iron-bearing minerals, black mica and magnetite, and accessory minerals such as zircon and corundum. Its high alumina content (20 to 30 percent compared with 17 to 20 percent in most commercial feldspars) has made it especially desirable in the manufacture of glass. Continued research has broadened possible applications to other branches of ceramics, such as pottery, sanitary and electrical porcelain, floor and wall tile, and glazes. Its most active market, however, is in the manufacture of glass.

In recent years the nepheline syenite used in ceramics in the United States has originated almost wholly from the Blue Mountain deposits of American Nepheline, Ltd., near Lakefield, Peterborough County, Ontario. Diamond drilling in the original producing area has disclosed the existence of substantial reserves. Open-pit quarrying is to be replaced by underground mining.[11] At the end of 1946 a new 300-ton mill was being erected at the mine site at Blue Mountain.

Part of the crude ore is to be ground at the new mill principally for the glass trade, and the balance shipped to Rochester for finer grinding and processing at the company plant there. It is planned eventually to install fine-grinding mills at Blue Mountain.[12] Port Coldwell Mines & Metals, Ltd., with deposits on the northern shore of Lake Superior and in the Bancroft area in southern Ontario, engaged in diamond drilling during 1946. Further work in these areas, however, has been deferred temporarily.[13] The development of low-temperature multiple-flux bodies and glazes has been especially stressed in current research on the behavior of nepheline syenite incorporated into ceramic ware, at the Engineering Experiment Station, Ohio State University, Columbus, Ohio.[14]

In an investigation of the nephelite-bearing rocks in northwestern New Jersey, especially near Beemerville, it was found that the character and amount of mafic constituents apparently would not permit their use in ceramics, although they might be suitable for the manufacture of roofing granules or used locally for road ballast.[15]

The possibilities of using nepheline syenite from Arkansas as a constituent of ceramic ware are being studied by the Arkansas Resources and Development Commission.[16] Various methods of beneficiation, including flotation, were tested, to reduce the high-iron content. In addition to construction uses, another large outlet for Arkansas nepheline syenite would be in the manufacture of roofing granules.[17]

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[11] Ceramic Industry, vol. 48, No. 4, April 1947, p. 149.
[12] Northern Miner, American Nepheline Mill Makes Good Start: Vol. 33, No. 11, June 5, 1947, p. 32. Eng. and Min. Jour., vol. 147, No. 11, December 1946, p. 116.
[13] Canadian Mines Handbook, 1947, pp. 250–251.
[14] Koenig, J. H., Report of Committee on Research: Bull. Am. Ceram. Soc., vol. 26, No. 6, June 15, 1947, p. 195.
[15] Parker, John M., III, Possible Utilization of Nephelite Bearing Rocks of Northwestern New Jersey: Geol. Survey, U. S. Dept. of the Interior, in cooperation with New Jersey Bureau of Mineral Research, Rutgers Univ., New Brunswick, N. J., 1946, 8 pp. (mim.).
[16] Crockett, William E., and Foxhall, Harold B., Occurrence and Properties of Nepheline Syenite: Brick and Clay Record, vol. 108, No. 5, May 1946, p. 39. Ceram. Ind., vol. 46, No. 6, June 1946, p. 37. Eng. and Min. Jour., vol. 147, No. 4, April 1946, p. 132.
[17] Engineering and Mining Journal, vol. 147, No. 1, January 1946, p. 105.

Imports for consumption of crude nepheline syenite into the United States in 1946 were slightly higher in both quantity and value than in 1945 and were the largest yet reported—51,852 short tons valued at $206,613. The tonnage of ground nepheline syenite imported totaled 1,018 tons valued at $11,137, only a little less than in 1945. All imports of both crude and ground material originated in Canada.

Nepheline syenite imported for consumption in the United States, 1942–46

Year	Crude		Ground		Year	Crude		Ground	
	Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
1942	35,990	$120,688	4	$44	1945	51,785	$194,975	1,073	$11,461
1943	43,105	150,225	737	7,680	1946	51,852	206,613	1,018	11,137
1944	39,043	136,664	-------	-------					

Quotations on crude nepheline syenite are not reported in trade journals; however, average values per short ton (estimated foreign market value) of imports for consumption in the United States have continued to rise as indicated by the following data: 1941, $3.13; 1942, $3.35; 1943, $3.49; 1944, $3.50; 1945, $3.77; and 1946, $3.98. During 1946 and the two prior years, ground nepheline syenite was quoted in Oil, Paint and Drug Reporter as follows (per short ton in bulk, f. o. b. Rochester, N. Y.): Glass-grade, 24-mesh, $12 per ton; pottery-grade, 200-mesh, $15.50 per ton. Packed in bags, prices are $2 higher.

APLITE

Virtually the entire output of aplite is used in making glass, particularly for containers, with small quantities consumed in enamel plants. The greatly increased demand for these products in 1946 resulted in an increase of nearly 45 percent in sales of aplite compared with 1945 and established a new record. Figures, however, may not be shown, as to do so would reveal operations of individual companies. The effect of calcination on the grindability of aplite rock and certain of its constituents has been studied at Battelle Memorial Institute, Columbus, Ohio.[18]

Aplite is mined in Amherst and Nelson Counties, Va., by two firms: Dominion Minerals, Inc., Piney River, Va. (the first company to begin mining) and Carolina Mineral Co., Inc., Kona, N. C., a subsidiary of Consolidated Feldspar Corp., Trenton, N. J. Both firms operate mills near Piney River.

TECHNOLOGY

The depletion of known feldspar reserves, especially in Southern and Eastern States, has led to extensive prospecting in order to develop new deposits. Coupled with this exploration program has been an intensive investigation of mechanical and chemical means of making the large reserves of low-grade pegmatite feldspar available for com-

[18] Koenig, J. H., Report of Committee on Research: Bull. Am. Ceram. Soc., vol. 26, No. 6, June 15, 1947, pp. 192–198.

mercial exploitation. Of particular interest during 1946 was the increasing application of froth flotation as a means of achieving these objectives. The basic fundamentals of this method of recovery and its technical aspects as applied to the feldspar industry were discussed by Koenig.[19]

Comprehensive discussions of froth flotation, including a description of the Steffensen air-flotation machines and a listing and evaluation of the various types of oils and reagents available was published during 1946 in a series of articles by Barr.[20] Experiments with froth flotation of granite fines to recover mica, feldspar, and quartz concentrates as a byproduct of granite quarrying operations were reported at the Lithonia, Ga., plant of Consolidated Quarries Corp.[21]

WORLD REVIEW

The world output of feldspar in 1946 was estimated at 650,000 metric tons. This total does not include the output in several countries (Brazil, China, Czechoslovakia, and U. S. S. R.) where mining of feldspar is known, but for which no data are available upon which to base even an estimate.

In recent years the United States has produced approximately 75 percent of the estimated world output of feldspar. Other countries reporting sizable shares of the remainder in normal years were Australia, Canada, France, Germany (Bavaria), Japan, Norway, and Sweden. Small quantities in 1946 also were mined in many other parts of the world.

A discussion of the mineral occurrences near Parry Sound in Ontario included a description of the feldspar deposits in this area and a number of analyses.[22] A brief account of the clay, feldspar, and other deposits in British Columbia was given by Cummings.[23] The potash feldspar deposits of Scotland, particularly in South Harris, as well as in other parts of the country were described by Robertson.[24] Studies of the use of Swedish feldspar in glass compositions were published.[25] The importance of European feldspar deposits and their relation to the ceramic industry in that area was stressed by Dittler.[26] Analyses were published of Indian feldspars from Bihar and the Madras Presidency.[27]

[19] Koenig, E. W., Froth Flotation as Applied to Feldspar: Ceram. Age, vol. 47, No. 5, May 1946, pp. 192-193.

[20] Barr, James A., Jr., Froth Flotation: Rock Products, vol. 49, No. 7, July 1946, pp. 65-67, 99-100; A Mechanical View of Flotation Processes: No. 8, August 1946, pp. 128-132; The Flotation Machine for Non-Metallics: No. 9, September 1946, pp. 71-75; A Chemical View of Flotation Processes: No. 10, October 1946, pp. 92-94; Flotation Chemicals for Non-Metallic Minerals: No. 12, December 1946, pp. 88-93, 124-125.

[21] Rock Products, vol. 50, No. 5, May 1947, p. 100.

[22] Satterley, J., Mineral Occurrences in the Parry Sound District: Ontario Dept. Mines, Ann. Rept. 1942, vol. 51, p. 11, 1943, 86 pp. Chem. Abs., vol. 40, No. 9, May 10, 1946, p. 2421.

[23] Cummings, J. M.; Clay Products Industry in British Columbia: Jour. Canadian Ceram. Soc., vol. 15, 1946, pp. 48-51. Jour. Am. Ceram. Soc., vol. 30, No. 2, Feb. 1, 1947, p. 53.

[24] Robertson, T., Scottish Sources of Alkali Feldspar: Geol. Survey Gt. Britain (Scotland) Wartime Pamphlet, 44, 1945, 37 pp. Jour. Am. Ceram. Soc., vol. 30, No. 2, Feb. 1, 1947, p. 44.

[25] Hedvall, J. A., and Aberg, N., (Experiments on the Use of Swedish Feldspar for the Manufacture of Glass): Tek. Tid., vol. 72, No. 41, 1942, pp. 73-75. Chem. Zentralb., 1943, I, p. 664. Chem. Abs., vol. 39, No. 5, Mar. 10, 1945, p. 1029.

Hedvall, J. A., Simmingskold, B., and Frolick, A., (Crystallization of Glass Masses and its Dependence on Raw Materials and Admixtures): Arkiv Kemi, Mineral., Geol. A 19, No. 27, 1945, 21 pp. Chem. Abs., vol. 41. No. 7, Apr. 10, 1947, col. 2219.

[26] Dittler, E., (European Feldspar Deposits and their Significance in Ceramics): Keram. Rundschau, vol. 50, 1942, pp. 57-60. Jour. Am. Ceram. Soc., vol. 30, No. 1, Jan. 1, 1947, p. 19.

[27] Misra, M. D., Chemical analyses of Some Indian Feldspars: Trans. Indian Ceram. Soc., vol. 2, 1943, pp. 11-14. Chem. Abs., vol. 40, No. 15, Aug. 10, 1946, p. 4492.

World production of feldspar, 1939–46, by countries, in metric tons [1]

[Compiled by B. B. Mitchell]

Country [1]	1939	1940	1941	1942	1943	1944	1945	1946
Argentina (shipments)	1,051	1,220	2,981	5,622	2,000	3,468	(2)	(2)
Australia:								
New South Wales [3]	51	64	452	1,469	3,890	4,756	3,785	(2)
South Australia [3]	615	1,072	1,081	1,026	522	818	955	1,317
Victoria	-------	10	69	175	58	143	217	-------
Western Australia	3,853	3,561	4,173	3,304	2,351	1,990	1,254	1,822
Canada (shipments)	11,306	19,464	23,623	20,203	21,644	21,327	27,439	32,993
Chile	-------	-------	-------	-------	8	(2)	124	(2)
Egypt	74	138	52	19	20	50	40	(2)
Finland (exports)	5,596	721	1,223	2,328	1,288	2,080	233	(2)
France	(2)	(2)	(2)	14,870	19,340	9,609	8,433	26,557
Germany: Bavaria	11,436	12,762	12,973	12,332	12,824	41,200	(2)	(2)
India	501	999	1,257	2,100	(2)	(2)	(2)	(2)
Italy	12,473	10,538	12,758	-------	(2)	(2)	(2)	(2)
Japan	[4] 4,109	[4] 2,874	[4] 2,436	[4] 2,527	[4] 2,939	[4] 2,313	[4] 1,377	[5] 7,514
Madagascar	(2)	(2)	(2)	9	2	34	(2)	(2)
Norway	24,288	6,782	7,527	6,269	5,712	[6] 7,108	[6] 1,579	[6] 7,320
Palestine	(2)	(2)	(2)	(2)	85	65	37	(2)
Rumania	2,140	2,127	749	1,383	1,261	(2)	(2)	(2)
Spain	(2)	(2)	(2)	4,251	1,093	2,567	[7] 1,400	2,804
Sweden	40,792	22,222	21,988	19,243	25,879	15,537	15,172	(2)
Union of South Africa	(2)	(2)	(2)	(2)	(2)	669	(2)	(2)
United Kingdom:								
Great Britain	(2)	(2)	(2)	(2)	10	203	(2)	(2)
Northern Ireland	(2)	(2)	(2)	(2)	(2)	172	-------	(2)
United States (sold or used)	257,534	295,430	344,299	321,240	313,126	332,663	379,042	516,539
Uruguay	(2)	(2)	(2)	(2)	(2)	264	265	(2)
Total [8]	390,000	400,000	450,000	425,000	425,000	460,000	480,000	650,000

[1] In addition to countries listed, feldspar is produced in Brazil, China, Czechoslovakia, and U. S. S. R. but data are not available.
[2] Data not available.
[3] Includes some chinastone.
[4] Preliminary data for fiscal year ended March 31 of year following that stated.
[5] January to October, inclusive.
[6] Exports.
[7] January to September, inclusive.
[8] Estimated by senior author of the chapter. No estimates are included for countries listed in footnote 1.

Ferro-Alloys[1]

By NORWOOD B. MELCHER

GENERAL SUMMARY

FERRO-ALLOY supply was generally easy during 1946 as a result of a 30-percent decline in the output of alloy steel. However, the production of stainless steel continued close to that of the record year 1945 and resulted in a peacetime peak in requirements for ferrochromium. With the exception of manganese and tungsten, the ferro-alloying materials closely follow the trend of alloy-steel production. Manganese, chiefly in the form of ferromanganese, is used in the manufacture of all grades of steel and therefore follows the trend in total steel production more closely than that of alloy steel. Tungsten finds its main use in the manufacture of cutting tools, and therefore the consumption of tungsten alloys (mainly ferrotungsten) is closely related to the combined production of alloy and carbon steel.

Except for molybdenum, silicon, and vanadium, the United States depends largely on foreign sources of ore for the manufacture of ferro-alloys. Imports continued at a high rate throughout 1946 and in the case of manganese established a record.

PRODUCTION AND SHIPMENTS

The production of ferro-alloys in 1946 totaled 1,480,975 net tons, compared with 1,732,423 net tons in 1945—a decrease of 15 percent. In 1946 ferro-alloys were made at 14 blast-furnace plants, 19 electric-furnace plants, and 2 aluminothermic furnace plants; in addition, 2 plants using electric furnaces produced ferrosilicon, and 5 produced ferrophosphorus as a byproduct. Shipments of all classes of ferro-alloys decreased 7 percent in quantity and 16 percent in value from 1945. Pennsylvania again was by far the largest producer and shipper of ferro-alloys in 1946, both in tonnage and value. Of the ferro-alloys shipped in 1946, Pennsylvania contributed 29 percent of the total tonnage and 33 percent of the value; New York was second, with 21 percent of the tonnage and 26 percent of the value. In addition, production and shipments of ferro-alloys were reported from Alabama, California, Iowa, New Jersey, Ohio, Oregon, South Carolina, Tennessee, Virginia, Washington, and West Virginia.

[1] In preceding issues of Minerals Yearbook ferro-alloys were discussed in the chapter Pig Iron, Ferro Alloys, and Steel.

Ferro-alloys produced and shipped from furnaces in the United States, 1945–46

Alloy	1945			1946		
	Production (net tons)	Shipments		Production (net tons)	Shipments	
		Net tons	Value		Net tons	Value
Ferromanganese	619,760	610,376	$78,907,189	491,973	493,808	$61,355,778
Spiegeleisen	139,039	157,774	5,108,144	111,696	114,982	3,793,673
Ferrosilicon	660,403	615,596	34,968,350	614,422	681,812	38,965,488
Ferrophosphorus	27,958	10,358	623,791	28,747	14,315	832,408
Ferrotungsten	4,107	3,987	11,865,019	1,350	1,491	4,310,055
Ferrotitanium, Ferrovanadium, Ferromolybdenum, Molybdic oxide, Calcium molybdate and compounds	11,480 / 23,150	10,353 / 19,615	79,037,164	6,188 / 9,901	7,193 / 11,844	67,016,253
Other varieties [1]	246,526	233,598		216,698	226,179	
	1,732,423	1,661,657	210,509,657	1,480,975	1,551,624	176,273,655

[1] Silicomanganese, manganese briquets, ferrochromium, ferrocolumbium, ferroboron, zirconium-ferrosilicon, alsifer, grainals, and simanal.

Ferromanganese.—The ferromanganese produced in 1946 averaged 79 percent manganese and came from eight blast-furnace plants and three electric-furnace plants. Of the manganese ore used in 1946 for manufacture of ferromanganese, 90 percent was foreign. During 1946 steel producers used 12.6 pounds of metallic manganese as ferroalloys per ton of steel produced. Of this quantity, 11.1 pounds were in the form of ferromanganese; in addition to the 12.6 pounds, 0.1 pound was added directly to the steel in the form of manganese ore. A total of 501,260 tons of ferromanganese was consumed during the year—virtually all by the iron and steel industry. A detailed discussion of manganese alloys appears in the Manganese chapter of this volume.

Spiegeleisen.—Production and shipments of spiegeleisen in 1946 dropped 20 and 27 percent, respectively, from 1945. The output came from three blast-furnace plants and averaged 20.3 percent manganese. Shipments in 1946 totaled 114,982 tons valued at $3,793,673 f. o. b. furnaces, or $32.99 per ton compared with $32.38 in 1945 and $31.23 in 1944. Five-tenths pound of metallic manganese in the form of spiegeleisen was used per ton of steel produced in 1946.

Ferrosilicon.—Shipments of ferrosilicon from furnaces during 1946 accounted for 44 percent of the total tonnage of ferro-alloys during the year, and the value of shipments represented 22 percent of the total. Of the 614,422 tons of ferrosilicon produced, 38 percent or 231,187 tons were made in blast furnaces and 62 percent (383,235 tons) in electric furnaces. Included in the latter figure are 149 tons of ferrosilicon produced as a byproduct in the manufacture of artificial abrasives. The ferrosilicon made in blast furnaces is known as silvery pig iron, and the silicon content of this grade made in 1946 averaged 9.2 percent; electric furnace output—mostly ferrosilicon containing over 20 percent—averaged 37.8 percent Si. Shipments of all grades of ferrosilicon, including silvery pig iron, totaled 681,812 net tons valued at $38,965,488. Exports in 1946 totaled 3,163 net tons valued at $244,625. Imports for consumption were 12,598 tons containing 1,331 tons of silicon and were valued at $260,695.

In 1946 producers of steel ingots and castings consumed 22 percent of the silvery pig iron. Companies that produce steel castings but not steel ingots used 4 percent, and miscellaneous users—mainly gray-iron foundries—74 percent. In 1945 the latter group used only 50 percent, showing the increase in demand for silicon alloys by the foundry industry. This increase is largely the outcome of a heavy demand for the housing program, which requires a large percentage of castings high in silicon. The most important grade of ferrosilicon is the standard 50 percent, which is employed as a deoxidizer and solidifier in the manufacture of most grades of killed and semikilled steel. Only a small quantity of this alloy is used in foundries and other industries. Alloys containing 75 percent silicon and over are used in ladle additions in gray-iron foundries and in the manufacture of high-silicon steel for use in electrical equipment and high-silicon spring steel. The accompanying table shows the consumption of various grades of ferrosilicon according to major consuming industry groups.

Consumption of ferrosilicon, silicon metal, and miscellaneous silicon alloys in the United States in 1946, by industries, in net tons

Alloy	Steel ingots and castings [1]	Steel castings [1]	Miscellaneous	Total
Silvery pig iron:				
5–20 percent silicon	83,611	15,569	279,072	378,252
Ferrosilicon:				
50 percent silicon	111,205	14,398	11,566	137,169
75 percent silicon	35,885	211	1,828	37,924
Other grades [2]	22,534	377	32,890	55,801
	253,235	30,555	325,356	609,146

[1] Data for castings made by companies that also produce steel ingots are included with "Steel ingots and castings" and excluded from "Steel castings."
[2] Includes grades of ferrosilicon not listed separately, silicon metal, and miscellaneous silicon alloys.

Ferrophosphorus.—All ferrophosphorus in 1946 was produced in electric furnaces as a byproduct in the manufacture of phosphate fertilizers and other chemicals. Shipments from producing plants totaled 14,315 net tons valued at $832,408 compared with 10,358 tons valued at $623,791 in 1945. Exports of ferrophosphorus in 1946 totaled 1,228 net tons valued at $80,037.

Ferrotungsten.—A lessening in the requirements for ferrotungsten resulted in a drop in the production of this alloy from 4,107 net tons in 1945 to 1,350 tons in 1946. Shipments in 1946 amounted to only 1,491 tons, containing 1,149 tons of W and valued at $4,310,055. The ferrotungsten was produced in electric furnaces, mainly from foreign ores, but some domestic ore—mostly from California and Nevada—was used. In all, 2,400 net tons of tungsten concentrates (reduced to an equivalent of 60 percent WO_3) were converted to ferrotungsten in 1946. United States consumption of ferrotungsten totaled 1,474 tons containing 1,178 tons of W, compared with 3,622 and 2,887 tons, respectively, in 1945. Exports of ferrotungsten in 1946 were only 91 tons valued at $270,325.

Ferrochromium.—All of the ferrochromium output in the United States in 1946 was produced in electric furnaces, mainly from foreign ores. Domestic consumption of ferrochromium in 1946 totaled

122,562 net tons compared with 144,447 tons in 1945. Exports in 1946 increased 70 percent and amounted to 2,510 net tons valued at $732,221.

Ferromolybdenum.—The ferromolybdenum produced in 1946 was made by the aluminothermic process and in electric furnaces using domestic ores. This alloy was produced at Niagara Falls, N. Y., and Langeloth and Washington, Pa. A total of 218 tons worth $61,489 was exported during the year.

Molybdic Oxide, Calcium Molybdate, and Molybdenum Compounds.—As these compounds were used as alloying agents in the production of iron and steel, they are included with ferro-alloys. These materials are much less expensive than ferromolybdenum and consequently are used to a greater extent. As with ferromolybdenum, these compounds are made with virtually all domestic raw materials.

Ferrotitanium.—In 1946 most of the ferrotitanium was produced in electric furnaces, but a small quantity was made by the aluminothermic process. The ferrotitanium produced in 1946 averaged 19 percent titanium, and both foreign and domestic ores (ilmenite and rutile) were consumed in its manufacture. Ferrotitanium is used as a deoxidizer and scavenger in steel manufacture. When employed as a deoxidizer, ferrotitanium is charged in combination with silicon or some other deoxidizing agent, the titanium alloy being added as a final purifier. As an alloying agent, ferrotitanium prevents intergranular corrosion. Combined exports of ferrotitanium and ferrocarbontitanium in 1946 totaled 550 short tons valued at $63,723.

Ferrovanadium.—All ferrovanadium produced in 1946 was made in electric furnaces, and both foreign and domestic ores were used in its manufacture. The alloy averaged 43 percent vanadium in 1946 as in 1945. Fifty-seven tons valued at $161,289 were exported during the year.

Ferroboron.—Shipments of ferroboron in 1946 averaged 15.3 percent B. Ferroboron is used in special steels as a hardening agent, but it is also a highly efficient deoxidizer.

Ferrocolumbium.—Ferrocolumbium is used in stainless steels to prevent intergranular corrosion. It also reduces air hardening and oxidation at high temperatures in chromium steels. In 1946 the output of ferrocolumbium averaged 56 percent Cb and was produced in electric furnaces.

Zirconium-Ferrosilicon.—The zirconium-ferrosilicon produced in 1946 averaged 14 percent Zr. Zirconium, a powerful deoxidizer and scavenger, reduces age hardening and thereby improves deep drawing properties of sheet steel. It is used instead of ordinary ferrosilicon and is more effective.

Silicomanganese.—The silicomanganese produced in 1946 averaged 68 percent manganese as in 1945 and was made in electric furnaces.

Manganese Briquets.—The foundry industry is the principal user of manganese briquets, which are added to molten iron to overcome the harmful effects of sulfur and to act as a deoxidizer and scavenger. The briquets produced in 1946 averaged 58 percent manganese.

Producers of ferro-alloys in the United States in 1946

Producer	Plant	Alloy
American Agricultural Chemical Co.	South Amboy, N. J.	Ferrophosphorus (byproduct).
Bethlehem Steel Co.	Johnstown, Pa.	Ferromanganese.
Climax Molybdenum Co.	Langeloth, Pa.	Ferromolybdenum, calcium molybdate, molybdenum oxide, oxide briquets, molybdenum trioxide, sodium molybdate.
Electro Metallurgical Co.	Alloy, W. Va. Columbiana, Ohio Holcomb Rock, Va. Niagara Falls, N. Y. Portland, Oreg. Sheffield, Ala.	Ferromanganese, silicomanganese, manganese briquets, ferrosilicon, silicon briquets, zirconium-ferrosilicon, ferrochromium, chromium briquets, ferrotungsten, ferrovanadium, ferromolybdenum, ferrotitanium, ferroboron, ferrocolumbium.
General Abrasive Co., Inc.	Niagara Falls, N. Y.	Ferrosilicon (byproduct).
Globe Iron Co.	Jackson, Ohio	Silvery pig iron.
Hanna Furnace Corp.	Buffalo, N. Y.	Do.
Jackson Iron & Steel Co.	Jackson, Ohio	Do.
Keokuk Electro-Metals Co.	Keokuk, Iowa	Ferrosilicon, silvery pig iron.
E. J. Lavino & Co.	Reusens, Va. Sheridan, Pa.	Ferromanganese.
Metal & Thermit Corp.	Jersey City, N. J.	Ferrotitanium.
Molybdenum Corp. of America	Washington, Pa.	Ferrotungsten, ferromolybdenum, calcium molybdate, molybdenum oxide, ferroboron, manganese boride.
Monsanto Chemical Co.	Anniston, Ala. Columbia, Tenn.	Ferrosilicon (byproduct); ferrophosphorus (byproduct).
New Jersey Zinc Co.	Palmerton, Pa.	Spiegeleisen.
Ohio Ferro-Alloys Co.	Philo, Ohio Tacoma, Wash.	Ferrosilicon, simanal, ferrochromium.
Oldbury Electro-Chemical Co.	Niagara Falls, N. Y.	Ferrophosphorus (byproduct).
Permanente Metals Corp.	Permanente, Calif.	Ferrosilicon.
Pittsburgh Metallurgical Co.	Charleston, S. C. Niagara Falls, N. Y.	Ferrosilicon, silvery pig iron, ferrochromium, ferromanganese, silicomanganese.
Sloss-Sheffield Steel & Iron Co.	N. Birmingham, Ala.	Ferromanganese.
Southern Ferro Alloys Co.	Chattanooga, Tenn.	Ferrosilicon, silicon briquets.
Tennessee Products Corp.	Rockwood, Tenn.	Ferromanganese.
Tennessee Valley Authority	Muscle Shoals, Tenn.	Ferrophosphorus (byproduct).
Titanium Alloy Mfg. Co.	Niagara Falls, N. Y.	Ferrotitanium.
United States Steel Corp. subsidiaries	Ensley, Ala. Clairton, Pa. Duquesne, Pa. Etna, Pa.	Ferromanganese, spiegeleisen.
Vanadium Corp. of America	Niagara Falls, N. Y. Bridgeville, Pa.	Ferrosilicon, silicon briquets, alsifer, ferrochromium, ferrovanadium, ferrotitanium, grainals.
Victor Chemical Works	Mt. Pleasant, Tenn.	Ferrophosphorus (byproduct).

FOREIGN TRADE [2]

Imports and exports of the rarer ferro-alloys are not recorded separately but are grouped as shown in the following tables. Ferromanganese and ferrosilicon comprised most of the imports in 1946.

[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Ferro-alloys and ferro-alloy metals imported for consumption in the United States, 1945–46,[1] by varieties

Variety of alloy	1945			1946		
	Gross weight (net tons)	Content (net tons)	Value	Gross weight (net tons)	Content (net tons)	Value
Calcium silicide (calcium-silicon content)	(2)	(3)	$22	(2)	331	$87,647
Chrome or chromium metal				1	(2)	31
Ferrochrome or ferrochromium containing 3 percent or more of carbon	6,371	4,292	989,177	1,460	992	251,926
Ferromanganese:						
Containing not over 1 percent carbon				52	43	15,428
Containing over 1 and less than 4 percent carbon				8,521	6,991	1,686,723
Containing not less than 4 percent carbon	35,521	27,694	3,733,846	23,557	18,874	2,790,905
Ferrosilicon	23,067	7,191	936,006	12,598	1,331	260,695
Ferrotitanium				4	(2)	2,207
Manganese-boron, manganese metal, and spiegeleisen not more than 1 percent carbon (manganese content)				(2)	(4)	77
Manganese-silicon (manganese content)	(2)	5	7,891	(2)	114	20,892
Silicon-aluminum and aluminum-silicon				5	(2)	1,040
Spiegeleisen	3,146	(2)	142,883	360	(2)	17,512
Tungsten and combinations, in lumps, grains, or powder:						
Tungsten metal (tungsten content)				(2)	6	19,076
Combinations containing tungsten or tungsten carbide (tungsten content)				(2)	(5)	143

[1] Changes for table in Minerals Yearbook, 1945, p. 584, are as follows: Silicon content of ferrosilicon in 1944 should read "4,267 net tons valued at $750,579."
[2] Not recorded. [3] 164 pounds. [4] Less than 1 pound. [5] 2 pounds.

Ferromanganese and ferrosilicon imported for consumption in the United States, 1945–46,[1] by countries

Country	Ferromanganese (manganese content)				Ferrosilicon (silicon content)			
	1945		1946		1945		1946	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Canada	27,694	$3,733,846	18,313	$2,907,253	7,191	$936,006	1,331	$260,695
Norway			7,595	1,585,803				
	27,694	3,733,846	25,908	4,493,056	7,191	936,006	1,331	260,695

[1] Changes for table in Minerals Yearbook, 1945, p. 585, are as follows: Ferrosilicon imported from Canada in 1944 should read "4,267 net tons valued at $750,579."

Ferro-alloys and ferro-alloy metals, exported from the United States, 1944–46, by varieties

Variety of alloy	1944		1945		1946	
	Net tons	Value	Net tons	Value	Net tons	Value
Ferromanganese	600	$101,445	836	$175,556	2,951	$381,194
Spiegeleisen	202	6,508	2,393	82,699	7,513	271,827
Other ferro-alloys	7,978	9,307,248	5,381	3,442,388	8,187	2,070,283

Fluorspar and Cryolite

By HUBERT W. DAVIS AND GERTRUDE N. GREENSPOON[1]

FLUORSPAR

GENERAL SUMMARY

GREATLY reduced activity at steel mills, the chief consumer of fluorspar (owing chiefly to strikes at steel plants and coal mines), coupled with a decreased demand for hydrofluoric acid adversely affected the fluorspar industry in 1946.

Despite a 15-percent decline in consumption of fluorspar in 1946 compared with 1945, a peacetime record was established. Lessened use of fluorspar at steel and hydrofluoric-acid plants was partly offset by a gain in usage at glass plants.

Although production and shipments of fluorspar were 15 and 14 percent, respectively, less than in 1945, they also established peacetime records. Illinois maintained its rank as the premier producer of fluorspar in 1946 by supplying 56 percent of the total domestic shipments. Illinois and New Mexico were the only fluorspar-producing States to record increases in 1946.

Salient statistics of fluorspar in the United States, 1937–46, in short tons

Year	Shipments from domestic mines	Foreign trade		Consumption	Industry stocks at end of year		
		Imports for consumption	Exports		Consumers' plants	Domestic mines [1]	Total
1937	181,230	37,063	456	194,300	90,100	30,539	120,639
1938	80,403	19,622	788	115,100	71,800	34,996	106,796
1939	182,771	16,302	2,976	176,800	90,400	38,619	129,019
1940	233,600	11,873	8,432	218,500	102,100	43,866	145,966
1941	320,669	7,524	12,184	303,600	108,900	31,997	140,897
1942	360,316	2,151	9,020	360,800	96,000	19,429	115,429
1943	406,016	43,769	9,068	388,885	105,933	19,026	124,959
1944	413,781	87,200	1,980	410,170	98,446	19,021	117,467
1945	323,961	103,133	1,420	356,090	103,148	[2] 19,863	[2] 123,011
1946	277,940	29,852	1,729	303,190	98,663	18,957	117,620

[1] Finished fluorspar only.
[2] Revised figure.

When the war with Japan ended, consumption of acid-grade fluorspar in the manufacture of hydrofluoric acid declined abruptly to an average of about 4,800 tons monthly in the last 4 months of 1945 and remained low in the first quarter of 1946. As a consequence

[1] Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

of greatly increased demand for fluorine chemicals, however, consumption during the latter half of 1946 was at an annual rate of 100,000 tons. Liquefied fluorine was put on the market for the first time in 1946, and although production was on a limited commercial basis for experimental use, scientists predict a new field of chemistry in the development of fluorine compounds.[2] According to McBee: [3]

> Before the war fluorine was generated in gram quantities with difficulty. It could not be purchased at any price. Now fluorine can be produced at reasonable cost on a large scale. Already it has been used in major industrial fluorinations. In 1947 fluorine will probably be offered to the industry by several chemical companies.

Ceramic-grade fluorspar was in short supply during some periods of 1946 as a result of expanded demand by the glass and enamel trades. Usage of fluorspar by manufacturers of glass established an all-time high in 1946. Many makers of glass who heretofore had not used fluorspar began employing it in 1946. Enamelers consumed more fluorspar in 1946 than in any other year except 1941. The larger use of fluorspar in enamel may foretell an upward trend of substantial magnitude, inasmuch as the housing program features built-in shelves and closets of porcelain enamel. Consequently, should the production schedule for these houses gain momentum, a corresponding increase in demand for fluorspar would follow.

Deliveries of fluorspar to consumers in the United States totaled 298,367 short tons in 1946 (272,304 tons from domestic mines and 26,063 tons from foreign sources); in addition, 3,907 tons of finished fluorspar from domestic mines were delivered to the Government stock pile. In 1945, deliveries to consumers totaled 357,624 tons (313,092 tons from domestic mines and 44,532 tons from foreign sources); in addition, 9,449 tons of finished fluorspar from domestic mines were delivered to the Government stock pile. Total deliveries to steel plants in the United States declined to 154,614 tons (207,100 tons in 1945), and those to hydrofluoric-acid plants dropped to 84,190 (102,734 tons in 1945); sales to glass and enamel plants advanced to 47,483 tons (36,508 tons in 1945).

The average composite selling price ($32 a short ton) of all grades of fluorspar (both domestic and foreign) delivered to consumers in the United States was $1.28 more than in 1945.

The total quantity of fluorspar shipped in and imported into the United States from about 1870 through 1946 was approximately 7,955,000 short tons, comprising about 83 percent from domestic mines and 17 percent from foreign sources.

The high rate of extraction of domestic fluorspar in recent years (nearly 2,800,000 tons of finished fluorspar in the decade 1937–46) has been of much concern to many consumers and producers; as a consequence, there was much activity on the part of several large users and producers in acquiring additional reserves of this mineral in 1946.

[2] Chemical Industries, Fluorine Chemistry Achieves Commercial Stature: Vol. 54, No. 6, December 1946, pp. 1006–1011.
[3] McBee, E. T., Fluorine Chemistry: Ind. Eng. Chem., vol. 39, No. 3, March 1947, pp. 236–237.

Fluorspar shipped [1] from mines in the United States, 1880–1946, by States, in short tons [2]

Year	Arizona	Colorado	Illinois	Kentucky	Nevada	New Mexico	Other States [3]	Total
1880–1909 [4]	718	5,807	330,120	203,929	-------	710	1,020	542,304
1910–19 [4]	843	83,220	1,004,633	281,124	400	20,997	6,110	1,397,327
1920–29 [4]	181	71,920	630,804	512,518	2,344	31,216	2,319	1,251,302
1930–39 [4]	3,351	50,935	466,595	515,727	14,693	23,931	3,090	1,078,322
1940	1,370	11,032	104,698	103,939	5,803	6,616	142	233,600
1941	1,428	15,566	133,333	142,862	8,967	17,591	922	320,669
1942	714	31,743	161,949	134,133	8,020	22,542	1,215	360,316
1943	1,328	49,145	198,789	109,849	8,653	37,050	1,202	406,016
1944	976	65,209	176,259	112,791	7,293	42,973	8,280	413,781
1945	1,126	52,437	147,251	95,142	7,038	14,449	6,518	323,961
1946	389	32,539	154,525	63,143	6,234	17,584	3,526	277,940

[1] Figures for 1880–1905 represent production.
[2] Figures on production not recorded for Colorado before 1905, for Illinois before 1880, and for Kentucky before 1886 and for 1888–95; total unrecorded production, chiefly from Illinois, estimated at 25,000 tons.
[3] California, New Hampshire, Tennessee, Texas, Utah, Washington, and Wyoming.
[4] Figures, by years, for 1880–1909 are given in Mineral Resources of the United States, 1925, pt. II, p. 13; for 1910–39 in Minerals Yearbook, Review of 1940, p. 1297.

Fluorspar imported into the United States, 1910–46, by countries, in short tons [1]

Year	Africa	Canada	France	Germany	Mexico	Newfoundland	Spain	United Kingdom	Other countries [2]	Total
1910–19 [3]	-------	2,433	-------	1,227	-------	-------	-------	183,265	11	186,936
1920–29 [3]	54,550	16,197	57,565	119,903	-------	-------	11,774	178,482	16,161	454,632
1930–39 [3]	17,527	468	65,815	89,056	550	17,922	34,525	6,940	7,989	240,792
1940	-------	-------	5,735	-------	1,555	3,640	112	-------	829	11,871
1941	-------	-------	-------	-------	4,452	-------	3,070	2	-------	7,524
1942	-------	(4)	-------	-------	2,151	-------	-------	-------	-------	2,151
1943	570	-------	-------	-------	20,515	7,144	15,540	-------	-------	43,769
1944	3,557	69	-------	-------	58,324	16,072	9,177	1	-------	87,200
1945	-------	[5] 2,361	-------	-------	62,575	[5] 10,875	27,322	-------	-------	103,133
1946	-------	310	-------	-------	24,063	2,688	2,791	-------	-------	29,852

[1] Imports Aug. 1 to Dec. 31, 1909, totaled 6,971 tons. Earlier imports not separately recorded but estimated at 150,000 tons and virtually all from United Kingdom.
[2] Argentina, Australia, Austria-Hungary, Belgium, China, Czechoslovakia, Italy, Netherlands, Norway, Tunisia, and U. S. S. R. in Asia.
[3] Figures, by years, for 1910–39 are given in Minerals Yearbook, Review of 1940, p. 1298.
[4] Less than 1 ton.
[5] Bureau of Mines has determined that 1,691 tons credited to Canada by the U. S. Department of Commerce originated in Newfoundland.

PRODUCTION AND SHIPMENTS

Production of finished fluorspar totaled 277,300 short tons in 1946, including 129,359 tons of flotation concentrates. However, the production also includes 5,700 tons of finished fluorspar recovered from milling about 11,400 tons of crude ore that had been mined before 1946. Thus, total mine production (expressed in terms of finished fluorspar) was 271,600 tons in 1946 compared with 341,500 tons in 1945. Of the mine production in 1946, 5 mines (producing over 10,000 tons each) supplied 93,300 tons or 34 percent, 12 mines (producing 5,000 to 10,000 tons each) supplied 85,000 tons or 31 percent, 24 mines (producing 1,000 to 5,000 tons each) supplied 64,300 tons or 24 percent, and 11 mines (producing 500 to 1,000 tons each) supplied 8,000 tons or 3 percent; thus, 52 mines produced 250,600 tons or 92 percent of the total. Of the remaining output (21,000 tons or 8 percent), some (in quantities ranging from a few tons to 500 tons) came from

an undetermined number of small mines and prospects, but much was derived from treating tailings from previous milling operations.

In 1946 mines operated by consumers produced 60,800 tons of finished fluorspar compared with 101,348 tons in 1945.

Fluorspar shipments from domestic mines in 1946 aggregated 277,940 short tons valued at $9,038,969, decreases of 14 percent in quantity and 9 percent in value from 1945. Of the 1946 total, 51,428 tons were shipped by river or river-rail for delivery to consumers as compared with 52,718 tons in 1945.

Illinois (55 percent) and Kentucky (23 percent) supplied 78 percent of the fluorspar shipped in 1946 compared with 75 percent in 1945. Shipments from Illinois and Kentucky were 10 percent less than in 1945 compared with a loss of 26 percent from other producing States.

The average value of all grades of finished fluorspar shipped in 1946 was $32.52 a short ton ($1.97 more than the 1945 average).

The accompanying table shows shipments of fluorspar, by States, in 1945 and 1946.

Fluorspar shipped from mines in the United States, 1945–46, by States

State	1945			1946		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Arizona	1,126	$21,016	$18.66	389	$7,959	$20.46
Colorado	52,437	1,333,735	25.43	32,539	925,867	28.45
Illinois	147,251	5,014,807	34.06	154,525	5,493,642	35.55
Kentucky	95,142	2,832,945	29.78	63,143	1,889,454	29.92
New Mexico	14,449	390,331	27.01	17,584	489,607	27.84
Nevada	7,038	304,045	22.43	6,234	232,440	23.82
Texas	3,413			1,118		
Utah	2,973			2,370		
Washington	132			38		
	323,961	9,896,879	30.55	277,940	9,038,969	32.52

Fluorspar shipments in 1946 comprised 140,975 tons of fluxing gravel (including 9,129 tons of flotation concentrates, which were blended with fluxing gravel) and foundry lump, 136,681 tons of ground and flotation concentrates, and 284 tons of acid lump. The bulk of the fluxing-gravel and foundry-lump fluorspar was shipped to steel plants and iron foundries; but a comparatively small tonnage moved to plants making cement, ferro-alloys, nickel, basic refractories, and fluxing compounds, to smelters of secondary metals, and to the Government stock pile. Of the ground and flotation concentrates shipped in 1946, hydrofluoric-acid plants took 58 percent and glass and enamel plants 35 percent; the remainder went chiefly to aluminum- and magnesium-reduction works, to manufacturers of steel, ferro-alloys, and welding rods, and to smelters of secondary metals. Except for 15 tons to a steel plant and 2 tons to a nonferrous smelter, all the acid-lump fluorspar was shipped to hydrofluoric-acid plants.

The accompanying table shows shipments of fluorspar, by grades and industries, in 1945 and 1946.

Fluorspar shipped from mines in the United States, 1945–46, by grades and industries, in short tons

Grade and industry	1945	1946	Grade and industry	1945	1946
Fluxing gravel and foundry lump:			Ground and flotation concentrates:		
Ferrous	[1] 184,645	[1] 134,822	Ferrous	[1] [2] 6,791	[1] [2] 5,939
Nonferrous	1,170	1,410	Nonferrous	2,211	2,231
Cement	326	661	Glass and enamel	35,960	47,377
Miscellaneous	158	175	Hydrofluoric acid	79,562	78,780
Government stock pile	7,225	3,907	Miscellaneous	1,638	625
	[1] 193,524	[1] 140,975	Government stock pile	2,224	
Acid lump:			Exported	1,420	1,729
Ferrous	36	15		[1] 129,806	[1] 136,681
Nonferrous	2	2	Total:		
Hydrofluoric acid	593	267	Ferrous	191,472	140,776
	631	284	Nonferrous	3,383	3,643
			Cement	326	661
			Glass and enamel	35,960	47,377
			Hydrofluoric acid	80,155	79,047
			Miscellaneous	1,796	800
			Government stock pile	9,449	3,907
			Exported	1,420	1,729
				323,961	277,940

[1] Fluxing gravel includes (and flotation concentrates exclude) the following quantities of flotation concentrates blended with fluxing gravel: 1945, 4,182 tons; 1946, 9,129 tons.
[2] Includes pelletized gravel.

SHIPMENTS, BY USES

As is evident from the accompanying table and figure 1, the predominant purchaser of fluorspar is the steel industry, which also consumes substantial quantities of hydrofluoric acid and sodium fluoride, for which fluorspar is the basic material.

Fluorspar shipped from mines in the United States, 1945–46, by uses

Use	1945				1946			
	Quantity		Value		Quantity		Value	
	Percent of total	Short tons	Total	Average	Percent of total	Short tons	Total	Average
Steel	57.5	186,073	$5,182,059	$27.85	48.3	134,295	$3,843,038	$28.62
Iron foundry	1.1	3,422	94,852	27.72	1.8	4,855	137,507	28.32
Glass	10.0	32,300	1,033,737	32.00	14.3	39,837	1,306,005	32.78
Enamel	1.1	3,660	128,612	35.14	2.7	7,540	262,530	34.82
Hydrofluoric acid	24.7	80,155	2,896,267	36.13	28.5	79,047	3,111,291	39.36
Miscellaneous	2.3	7,482	254,560	34.02	2.4	6,730	221,001	32.84
Government stock pile	2.9	9,449	260,853	27.61	1.4	3,907	93,800	24.01
	99.6	322,541	9,850,940	30.54	99.4	276,211	8,975,172	32.49
Exported	.4	1,420	45,939	32.35	.6	1,729	63,797	36.90
	100.0	323,961	9,896,879	30.55	100.0	277,940	9,038,969	32.52

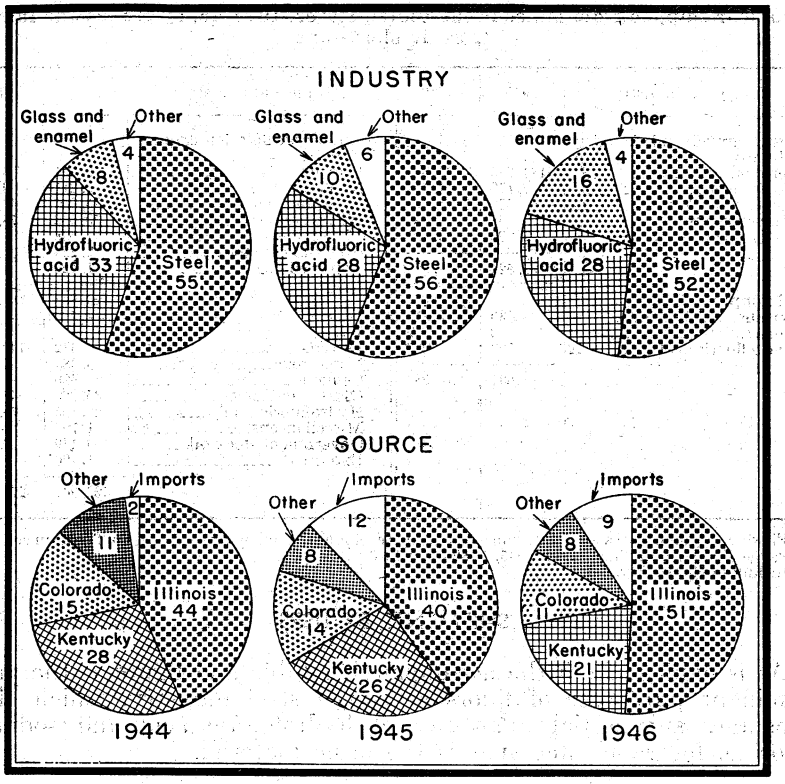

FIGURE 1.—Fluorspar sales (domestic and foreign) to consumers in the United States, 1944-46, by consuming industries and sources, in percent.

STOCKS AT MINES OR SHIPPING POINTS

According to the reports of producers, the quantity of fluorspar in stock at mines or shipping points at the close of 1946 totaled 87,299 tons, or 12 percent less than in 1945. These stocks comprised 18,957 tons of finished fluorspar and 68,342 tons of crude fluorspar (calculated to be equivalent to 34,000 tons of finished fluorspar).

Stocks of fluorspar at mines or shipping points in the United States, Dec. 31, 1945 and 1946, by States, in short tons

State	1945			1946		
	Crude [1]	Finished	Total	Crude [1]	Finished	Total
Arizona		[2] 28	[2] 28			
California	150		150	150		150
Colorado	3,674	790	4,464	4,207	579	4,786
Idaho	50		50	50		50
Illinois	33,639	10,328	43,967	28,814	10,006	38,820
Kentucky	2,382	7,877	10,259	3,129	8,007	11,136
Nevada		101	101			
New Mexico	[2] 39,665	[2] 348	[2] 40,013	31,992	226	32,218
Texas		[2] 185	[2] 185			
Utah		169	169		139	139
Washington		37	37			
	[2] 79,560	[2] 19,863	[2] 99,423	68,342	18,957	87,299

[1] This crude (run of mine) fluorspar must be beneficiated before it can be marketed.
[2] Revised figure.

CONSUMPTION AND CONSUMERS' STOCKS

The accompanying tables give data on consumption and consumers' stocks of fluorspar.

Fluorspar (domestic and foreign) consumed and in stock in the United States, 1945–46, by industries, in short tons

Industry	1945			1946		
	Consumption	Stocks at consumers' plants, Dec. 31	In transit to consumers' plants, Dec. 31	Consumption	Stocks at consumers' plants, Dec. 31	In transit to consumers' plants, Dec. 31
Basic open-hearth steel	176,488	67,800	5,871	145,631	65,341	3,005
Electric-furnace steel	20,873			14,898		
Bessemer steel	555			206		
Iron foundry	3,877	1,082	51	4,925	1,165	66
Ferro-alloys	2,909	1,013		2,044	927	
Hydrofluoric acid	109,315	20,757	506	83,901	17,431	1,810
Primary aluminum	1,190	665		1,417	1,182	
Primary magnesium	811	757				
Glass	31,874	5,962	681	39,852	7,136	1,414
Enamel	3,695	1,433	101	6,739	1,946	283
Welding rod	1,457	257		417	181	
Cement	365	1,214		608	1,262	
Miscellaneous	2,681	2,208	12	2,552	2,092	125
	356,090	103,148	7,222	303,190	98,663	6,703

Production of basic open-hearth steel and consumption and stocks of fluorspar (domestic and foreign) at basic open-hearth steel plants, 1942–46

	1942	1943	1944	1945	1946
Production of basic open-hearth steel ingots and castings—long tons	67,821,000	69,695,000	71,387,000	64,510,000	54,034,000
Consumption of fluorspar in basic open-hearth steel production—short tons	217,100	205,676	201,788	176,488	145,631
Consumption of fluorspar per ton of basic open-hearth steel made—pounds	6.4	5.9	5.7	5.5	5.4
Stocks of fluorspar at basic open-hearth steel plants at end of year—short tons	60,400	57,200	53,100	63,900	61,600

Fluorspar (domestic and foreign) consumed in the United States, 1927–46, in short tons

Year	Steel	Hydrofluoric acid	Glass	Enamel	Iron foundry and ferro-alloys	All other	Total
1927	142,700	15,500	6,800	5,800	3,900	1,500	176,200
1928	158,100	20,500	6,200	5,700	4,100	1,600	196,200
1929	162,100	15,600	6,600	5,200	3,800	1,500	194,800
1930	112,600	12,600	4,300	4,000	2,700	2,000	138,200
1931	69,300	12,000	7,100	3,000	1,300	1,300	94,000
1932	38,400	7,000	6,700	2,400	800	700	56,000
1933	64,700	7,800	7,000	3,200	1,200	700	84,600
1934	85,300	11,000	7,700	3,500	2,100	1,000	110,600
1935	105,000	12,900	11,000	4,900	2,600	1,000	137,400
1936	140,800	20,100	11,600	5,400	2,700	1,800	182,400
1937	146,400	24,100	11,600	5,900	3,700	2,600	194,300
1938	77,600	18,900	10,500	4,000	2,800	1,300	115,100
1939	123,800	26,300	15,300	6,100	3,500	1,800	176,800
1940	155,500	37,000	13,400	5,500	4,600	2,500	218,500
1941	210,400	56,000	20,300	7,300	5,100	4,500	303,600
1942	242,600	81,600	18,500	3,100	7,800	7,200	360,800
1943	234,148	113,614	20,592	1,726	7,260	11,545	388,885
1944	230,201	129,553	27,315	2,547	7,815	12,739	410,170
1945	197,916	109,315	31,874	3,695	6,786	6,504	356,090
1946	160,735	83,901	39,852	6,739	6,969	4,994	303,190

Fluorspar was reported consumed in 38 States and the District of Columbia in 1946, but 3 States—Illinois, Ohio, and Pennsylvania—used 166,465 tons or 55 percent of the total consumption. Pennsylvania was again the chief consuming State; it ranked first in consumption of fluorspar in both steel and glass but dropped from second to fourth place in hydrofluoric acid. Illinois maintained its rank as the largest consumer of fluorspar in hydrofluoric acid in 1946.

The accompanying table shows, so far as possible without revealing the figures of individual companies, the consumption of fluorspar, by States, in 1945 and 1946.

Fluorspar (domestic and foreign) consumed in the United States, 1945–46, by States, in short tons

State	1945	1946	State	1945	1946
Alabama, Georgia	9,177	7,101	Kentucky, Maryland	7,381	5,858
Arkansas, Louisiana, Mississippi, North Carolina, Florida	3,894	16,491	Maine, Massachusetts, Rhode Island	1,294	1,346
California	10,416	6,755	Michigan	9,168	8,052
Colorado, Iowa, Utah	11,460	8,184	Minnesota, Wisconsin	1,507	1,632
Connecticut	497	420	Missouri	2,577	2,197
Delaware, District of Columbia, New Jersey	31,314	25,361	New York	16,386	12,625
Illinois	54,397	49,311	Ohio	59,232	46,493
Indiana	27,355	26,435	Oklahoma	3,571	805
Kansas, Nebraska, Wyoming	141	166	Oregon, Washington	1,692	1,501
South Dakota			Pennsylvania	85,996	70,661
			Tennessee	1,491	1,856
			Texas	11,042	4,572
			Virginia	157	94
			West Virginia	5,945	5,274
				356,090	303,190

PRICES

Prices fixed by the Office of Price Administration on July 1, 1943, effective until November 9, 1946, were $30 to $33 a short ton for metallurgical-grade fluorspar and $37 a ton for acid and ceramic grades. The average selling price of all grades of domestic fluorspar shipped in 1946 was $32.52 a short ton—a new peak, compared with $30.55 in 1945.

INDUSTRY IN 1946, BY STATES

Arizona.—Production in Arizona in 1946, totaling 361 short tons, came from Cochise and Maricopa Counties and was shipped to steel plants. The fluorspar from Cochise County was from the Lone Star mine operated by Cooper Shapley, Jr., and that from Maricopa County was from the Union Hill mine operated by Harry Hershkowitz and the Jumbo mine operated by Raymond Contreras. A small quantity of fluorspar, a byproduct of the Sonora lead mine in Yuma County, was shipped from stock to a steel plant in 1946.

California.—No fluorspar was reported produced in California in 1946. However, at the plant of Industrial Minerals & Chemical Co. at West Berkeley some Nevada fluorspar was ground on a toll basis for the Continental Ore Co. and Balfour, Guthrie & Co.

Colorado.—Production of finished fluorspar in Colorado decreased to 32,400 tons in 1946 from 52,200 tons in 1945. In addition, some crude ore equivalent to 400 tons of finished fluorspar was mined but not milled in 1946. Thus, production (expressed in terms of finished fluorspar) totaled 32,800 tons in 1946 compared with 52,400 tons in 1945. Output came from Boulder, Chaffee, Jackson, Mineral, and Park Counties.

Shipments from Colorado were 32,539 tons in 1946 compared with 52,437 tons in 1945. The 1946 shipments comprised 7,993 tons of metallurgical-grade fluorspar and 24,546 tons of flotation concentrates.

On March 15, 1946, Harry M. Williamson & Son sold its flotation mill near Jamestown to the Ozark-Mahoning Co. but continued to operate the mines and furnish ore for the plant. Finished fluorspar produced y both operators was 33 percent less in 1946 than in 1945. Output of flotation concentrates, however, was 35 percent greater. Except for 14 tons of development ore from the Afterthought mine, all the ore treated in the mill in 1946 came from the Argo and Emmett mines in Boulder County. The Ozark-Mahoning Co. also operates a flotation mill in Illinois.

Production of flotation concentrates at the mill (near Jamestown) of General Chemical Co. was 23 percent less than in 1945. The flotation-mill feed comprised ore from the company-operated Alice, Burlington, Chancellor, Upper Alice, and Yellow Girl mines in Boulder County; from development at the Dostal mine in Chaffee County; and some purchased ore. The mines of the American Fluorspar Corp. and the flotation mill of the Fluorspar Processing Co., all near Salida, were sold to the General Chemical Co. in January 1946. The Salida flotation plant did not operate. This company also has a flotation mill in New Mexico.

Colorado Fluorspar Mines, Inc., which operates a combination, flotation-jig mill and a mine near Salida, Chaffee County, produced 29 percent less finished fluorspar than in 1945. Virtually the entire output in 1946 was flotation concentrates, whereas in 1945 almost half of the production was fluxing gravel.

The mine and flotation mill of United States Fluorspar, Inc., near Salida, operated sporadically until September 1946, when operations ceased; on October 22 the company went into receivership.

The Wagon Wheel Gap mine, in Mineral County, of the Colorado Fuel & Iron Corp., produced 13 percent less fluorspar than in 1945.

The Crystal mine near Northgate, Jackson County, operated by the Crystal Fluorspar Mines Co., produced and shipped several carloads of metallurgical-grade fluorspar in 1946. Some ore was reclaimed from the Kramer dump, also in Jackson County, by M. P. Cloonan and shipped to a cement plant.

A small quantity of fluorspar was produced (but not shipped) by Luke E. Smith from a property near Jefferson, Park County.

The heavy-media plant of Western Fluorspar Corp. near Northgate, which was closed August 26, 1945, remained idle throughout 1946.

The fluorspar deposits of Boulder County have been described by Goddard.[4]

[4] Goddard, E. N., Fluorspar Deposits of the Jamestown District, Boulder County, Colorado: Proc. Colorado Sci. Soc., vol. 15, No. 1, 1946, 47 pp.

Illinois.—Despite the decreased demand and the coal strikes, Illinois maintained its premier position as a fluorspar-producing State. Production of finished fluorspar was 154,300 tons in 1946; about 99.7 percent came from Hardin County and the remainder from Pope County. However, the production includes 4,400 tons of finished fluorspar recovered from crude ore mined before 1946. Consequently, total mine production (expressed in terms of finished fluorspar) was 149,900 tons in 1946 compared with 151,400 tons in 1945. Some Kentucky fluorspar is milled in Illinois, and some Illinois fluorspar is milled in Kentucky; the finished fluorspar so recovered, as well as that shipped, is credited in the statistics to the State of origin. The Argo, Austin, Blue Diggings, Cave in Rock, Crystal, W. L. Davis No. 2, Deardorff, Fairview, West Green, Hawkins, Hillside, Knox, Lead Hill, Midway-North Boundary-Air Shaft, Minerva, Recovery Shaft, Rosiclare, Victory, and Wall properties supplied about 97 percent of the fluorspar produced in Illinois in 1946; most of the remainder came from many mines and prospects, including the Clay Diggings, Douglas, Eureka, East Green, Hill, Humm, Pell, Renfro, Rose Creek, Sheldon, Stewart, Stone Hill, Sun Beam, Twitchell, and Winn; some was recovered from tailings from previous milling operations.

Shipments of fluorspar from Illinois (154,525 tons) were 5 percent more than in 1945 and contributed 56 percent of the total domestic shipped. Of the 1946 total, 40,486 tons were shipped by river or river-rail to consumers compared with 30,327 tons in 1945.

The Aluminum Ore Co. produced 4 percent more flotation concentrates from domestic ore than in 1945. The heavy-media separation unit was completed and put into operation in October 1946. The mill feed in 1946 comprised ore from the company-operated Argo, Blue Diggings, and Fairview mines. Development was carried on at the 600- and 700-foot levels of the Argo mine. An electric hoist, replacing a steam hoist, and electric pumps were installed in the Blue Diggings shaft in 1946.

The Crystal Fluorspar Co. produced 62 percent more finished fluorspar at its Crystal mine in 1946 than in 1945. Its output in 1946 included 1,861 tons of flotation concentrates derived from 5,487 tons of log-washer fines treated at the Patton flotation mill. Near the "Wye", 6 miles from Rosiclare, the company is developing the Jefferson property by a 300-foot shaft, of which 208 feet had been sunk at the close of 1946.

The gravity-concentrating mill of Inland Steel Co. was inactive about 9 months in 1946, and its flotation mill was operated at a greatly reduced rate; consequently, production of gravel and flotation concentrates was 71 and 56 percent, respectively, less than in 1945. The mill feed comprised ore from the Hillside and Wall mines at Rosiclare, Ill., the Barnes and Guill mines near Marion, Ky., and some purchased ore. Production and shipments of finished fluorspar from the Barnes and Guill mines have been credited to Kentucky in the statistics. The Inland Steel Co. carried on much development at some of its mines; at its Keystone mine near Marion, Ky., the No. 30 shaft was deepened from the 400- to the 500-foot level, a new 450-foot shaft was completed at the Guill mine, and development was under way at the Rock Candy mine in Illinois.

The flotation mill of Ozark-Mahoning Co. (successor to Mahoning Mining Co. on December 1, 1946) produced 5 percent more fluorspar concentrates from domestic ore than in 1945. The mill feed in 1946 comprised ore from the W. L. Davis No. 2, Deardorff, East Green, and West Green mines near Cave in Rock, Ill., the Mineral Ridge and Delhi-Babb mines near Salem, Ky., and some purchased ore. Production of finished fluorspar comprised 83.4 percent acid-grade, 15.4 percent pelletized gravel, and 1.2 percent filter cake; most of the filter cake was sold to local producers for blending with fluxing gravel. Production and shipments of finished fluorspar from the Mineral Ridge and Delhi-Babb mines have been credited to Kentucky in the statistics. During 1946, the company acquired the Delhi-Babb mine near Salem, Ky., but its lease on the Klondike mine near Smithland, Ky., was surrendered.

The Rosiclare Lead & Fluorspar Mining Co. operated the Eureka, Hawkins, Midway-North Boundary-Air Shaft, Recovery Shaft, and Rosiclare properties in 1946, but the Rosiclare mine was the chief producing mine of the company. The ore from the company mines is mill feed for its heavy-media, jig, and flotation units. Production of finished fluorspar of all grades was virtually the same as in 1945 but shipments were 10 percent larger. This company, together with the Pigmy Corp., a subsidiary, was the largest producer of fluorspar in the United States in 1946. A new three-conductor, 5,000-volt electric power cable to serve the pumping station at the 600-foot level was installed in the main shaft of the Rosiclare mine, and two 1,000-gallon-a-minute pumps were also being added for protection against flooding.

The mine and flotation mill of Minerva Oil Co. were operated at an increased rate in 1946, and output of flotation concentrates from domestic ore was 14 percent greater than in 1945. Additional equipment was installed in the flotation mill to increase its capacity and to permit finer grinding of the ore. Leases on a substantial acreage in Livingston County, Ky., have been acquired by the company.

Kentucky.—Production of fluorspar in Kentucky continued the downward trend that began in 1942. Much of the decline in 1946 resulted from a lengthy strike at the mines of the United States Coal & Coke Co. Production of finished fluorspar was 63,300 short tons in 1946. In addition, some crude ore equivalent to 600 tons of finished fluorspar was mined but not milled in 1946. Thus, total mine production (expressed in terms of finished fluorspar) was 63,900 tons in 1946 compared with 94,400 tons in 1945. Shipments also declined; they were 63,143 tons—a 34-percent drop from 1945 and the smallest since 1938. Of the 1946 shipments, 10,942 tons were shipped to consumers by river or river-rail compared with 22,391 tons in 1945.

Output in Caldwell County in 1946 was slightly less than in 1945 and was chiefly from the Bright, Crowder, Hollowell & Hobby, Tyrie, and Williamson mines. The Fluorspar Corp. has been organized to take over the Senator mine and adjoining Meadows property. Electric equipment was being installed in the Senator mine, where the shaft will be sunk to 325 feet; a heavy-media-process plant was under construction at the close of 1946.

The major part of the 1946 output in Crittenden County came from a few mines—Big Four, Blue, Davenport, Krausse, Pigmy, and Tabb.

Most of the remainder came from many smaller producing mines (including the Bachelor, Barnes, Crystal, Delhi-Babb, Gilless, Hayshed, Hodge, Waddell, and Watkins) and from numerous prospects; some was recovered from tailings from previous milling operations.

Production and shipments of fluorspar in 1946 by the United States Coal & Coke Co., the largest producer in Kentucky in 1945, were adversely affected by a strike at its mines and mill which began on April 26 and ended on October 1. As a consequence, output and shipments of finished fluorspar were 60 and 55 percent, respectively, less than in 1945. Production came chiefly from the company-operated Tabb mines, but some was from the Big Four mine owned by the company but operated by Perry & Loyd. Output at the Big Four mine, however, was only 13 percent smaller than in 1945.

The Kentucky Fluor Spar Co. and affiliates shipped 12 percent less fluorspar and "fluorbarite" than in 1945. The company operates a mill at Marion and, through its mining division (Roberts & Frazer), operated the C. R. Babb, Carr, and Wright mines in Livingston County. Only about 42 percent of the supply came from company mines in 1946; most of it was from the Nancy Hanks, Krausse, Austin, and Humm mines and the flotation mills of Minerva Oil Co. and Minerals Flotation Corp.

The Pigmy mine of the Pigmy Corp. (subsidiary of the Rosiclare Lead & Fluorspar Mining Co.) produced 32 percent less fluorspar than in 1945.

For the fifth successive year, output from the Bachelor mine of the Delhi Fluorspar Corp. declined. However, the company purchased both finished fluorspar and milling ore from many producers; its shipments were 42 percent less than in 1945. The company sold its Delhi-Babb mine, which includes the Bachelor mine, to Ozark-Mahoning Co. in 1946.

L. Conyer, who operated a jig mill near Marion, shipped 18 percent less fluorspar than in 1945. He purchases both finished fluorspar and milling ore from many local producers and all of his shipments came from these sources in 1946.

Crider Bros. Fluorspar Co. worked the Blue mine near Mexico, reclaimed some fluorspar from the Blue and Haffaw dumps, and purchased some fluorspar from local producers. Its sales were about double those of 1945.

The flotation mill at Marion of Minerals Flotation Corp. was operated throughout most of 1946 and made a substantial production of concentrates from tailings accumulated over a period of years.

Alco Minerals, Inc., acquired the Summers property near Salem, rehabilitated the mill, and added a battery of flotation cells. The mill feed comprised tailings from the Klondike, Davenport, Blue, Franklin, and other mines.

The Eagle Fluor Spar Co., one of the older companies in the Western Kentucky district, discontinued mining in 1946 and sold its mines and mills to the Aluminum Ore Co., which has also acquired the Old Silver and Atwood mines near Smithland, Ky., as well as other properties in Kentucky.

In Livingston County most of the output came from the C. R. Babb, Carr, Guill, Lovelace, Mineral Ridge, Nancy Hanks, and

Wright mines and from reworking the C. R. Babb, Klondike, and other tailings.

Output at the Carr and Wright mines of Roberts & Frazer was greater than in 1945. Its C. R. Babb mine was sold in January 1946 to the Pennsylvania Salt Manufacturing Co., which made a small output in the remainder of the year.

Production of gravel fluorspar at the Nancy Hanks mine, operated by W. V. Haynes, Jr., and Tinsley & Loyd, was 38 percent less than in 1945, and recovery of sand spar was 36 percent smaller.

Butler & Moodie continued to reclaim fluorspar from Klondike tailings.

In the Central Kentucky district, production and shipments of fluorspar advanced to 4,235 and 3,786 tons, respectively (1,040 and 1,097 tons in 1945). Output from this district in 1946 came from the Faircloth and Haydon mines in Woodford County near Wilmore; the Gobel Dean, Twin Chimney, and Lone Oak mines in Mercer County near Harrodsburg; and the Britton mine also in Mercer County near Salvisa. The Lone Oak mine was operated by Albert Brauer in 1946, while the other mines were worked by Gilbert & Hageman Co. (succeeded by Hageman Properties, Inc., on February 1, 1947). In 1946 log washers were installed at the Haydon and Gobel Dean mines, and 50-ton gravity-concentrating mills were completed to serve the Faircloth and Twin Chimney mines. The known ore reserves in the Britton mine were exhausted, and the mine was closed in November.

Nevada.—Shipments of fluorspar from Nevada (6,234 short tons) declined for the third successive year; they were 11 percent smaller than in 1945. Most of the 1946 total went to steel plants, but some was shipped to hydrofluoric acid, cement, glass, and enamel plants and an iron foundry. The fluorspar moving to glass and enamel plants was ground at the plant of Industrial Minerals & Chemical Co. at West Berkeley, Calif.

New Mexico.—Chiefly because of resumption of operations by Zuñi Milling Co. (which operated almost entirely on Mexican ore in 1945) and the Government-owned heavy-media plant at Gila, production of finished fluorspar (17,500 short tons) in New Mexico was 22 percent greater than in 1945. However, the production includes 2,300 tons of finished fluorspar recovered from ore mined before 1946. Consequently, total mine production (expressed in terms of finished fluorspar) was 15,200 tons in 1946 compared with 28,600 tons in 1945. The 1946 output came from Grant, Luna, Sierra, and Valencia Counties.

Shipments of fluorspar from New Mexico likewise increased and totaled 17,584 tons, a gain of 22 percent over 1945.

The flotation mill of General Chemical Co. at Deming produced 8 percent more concentrates from domestic ore than in 1945. The mill feed comprised ore from the company Shrine mine in Grant County and purchased ore from local mines.

The flotation mill of Zuñi Milling Co. at Los Lunas resumed production on October 15, 1946, and during the balance of the month it milled some Mexican ore which had remained at the plant when it suspended operations in August 1945. The concentrate recovered

from Mexican ore, as well as that shipped, is not included in the statistics on production and shipments. In early November the mill began operating on ore from the company mines near Grants in Valencia County and purchased ore from local mines.

The Government-owned heavy-media plant at Gila, inactive since January 1945, resumed operation on October 8, 1946. The plant is being operated by the Shattuck Denn Mining Co. as agent for the Office of Metals Reserve to treat the accumulated stock of ore at the mill; the resultant concentrates will be shipped to a Government stock pile.

At the Burro Chief mine near Tyrone, Grant County, operated by H. E. McCray, the 400-foot level was opened and a jig plant to serve the mine was put into operation. Production of finished fluorspar was more than double that of 1945 but output of milling ore, which is sold to local mills, was only one-fourth as much.

The flotation mill of Indian Metals Co. of New Mexico at Lordsburg resumed production in April and was operated sporadically during the remainder of 1946.

The Grattan flotation mill at Deming was operated during March and April by I. S. James on purchased ore from the Burro Chief and Foster mines.

The fluorspar deposits of New Mexico have been described by Rothrock and others.[5]

Texas.—Production and shipments (933 and 1,118 short tons, respectively) were 73 and 67 percent less than in 1945. Production was from the Eagle Mountains mine in Hudspeth County near Van Horn, operated by the Western Fluorite Co. until August 1, when it was acquired by J & L Fluorite Co. Virtually the entire output in 1946 was flotation concentrates.

Utah.—George Spor & Son, operating the Spor mine in Juab County near Delta, was the only producer of fluorspar in Utah in 1946. Output in Utah was 2,340 short tons in 1946 compared with 2,918 tons in 1945.

Washington.—The Mitchem mine in Ferry County near Keller and the small heavy-media plant which serves it were not in operation in 1946. A small quantity (38 tons) of concentrates produced in 1945 was shipped to a steel plant in 1946.

MILL DEVELOPMENTS

The trend toward the heavy-media and flotation processes for treating fluorspar ores continued in 1946. With these processes lower-grade ore can be mined and treated than is economical with jigs, much higher recoveries of fluorspar are attained, and higher-grade concentrates produced. Employment of these processes makes it possible to produce many thousands of tons of concentrates from material that heretofore was considered waste. In fact, since flotation was applied to the treatment of fluorspar in the United States in 1929, a large tonnage of concentrates has been recovered from tailings resulting from other milling operations. Consequently, the growing use of these processes has done much to retard the rate of depletion—

[5] Rothrock, H. E., and others, Fluorspar Resources of New Mexico: New Mexico Bureau of Mines and Mineral Resources Bull. 21, 1946, 245 pp.

nearly 280,000 tons annually in the past decade—of this important national resource.

The heavy-media unit of the Aluminum Ore Co., Rosiclare, Ill., was completed and put into operation in October 1946. This unit is designed to treat 25 tons of crude ore per hour and by rejecting one-third to one-half of the coarse material will supply an enriched product for flotation feed.

In 1946 the Fluorspar Corp. had a heavy-media separation plant under construction near Princeton, Ky., to serve the nearby Senator and Meadows mines. The concentrates produced will be feed for the flotation plant at Marion, Ky., of Minerals Flotation Corp., a subsidiary of the Fluorspar Corp.

The productive capacity of the flotation mill of Ozark-Mahoning Co. near Jamestown, Colo., was increased by 6 additional cells, a 26-foot thickening tank, and other equipment. The company flotation mill at Rosiclare was being enlarged by additional cells, a new cooler, and a new kiln.

The flotation operation in Illinois of the Mahoning Mining Co. (now Ozark-Mahoning Co.) has been described by Duncan.[6]

The beneficiation of fluorspar from the mine of Minerva Oil Co. has been described by Fine and O'Meara.[7]

Alco Minerals, Inc., added a battery of flotation cells to the Summers mill, near Salem, Ky., which it rehabilitated and put into operation in 1946.

In the latter part of 1946, St. Lawrence Fluorspar, Inc., completed and put into operation at Wilmington, Del., a drying plant with a capacity of 60 to 65 short tons of dry fluorspar per 24 hours. Filter cake from the flotation plant of St. Lawrence Corp. of Newfoundland, Ltd., will be dried at this plant.

Output of flotation concentrates from domestic ore totaled 129,359 short tons in 1946 compared with 121,670 tons in 1945. In addition, flotation mills in the United States recovered 354 and 17,374 tons, respectively, from milling Mexican ore in 1946 and 1945.

FOREIGN TRADE

Imports.—Receipts of imported fluorspar into the United States were 29,488 short tons in 1946—a loss of 71 percent from 1945, which, however, was an all-time high.

Fluorspar imported for consumption in the United States, which represents the quantity on which the duty was paid, was 29,852 tons—a loss of 71 percent from 1945. The imports in 1946 comprised 6,621 tons containing more than 97 percent calcium fluoride and 23,231 tons of lower grade. They were valued [8] at $516,815. The value assigned to the higher-grade foreign fluorspar averaged $23.99 a ton in 1946 and that to the lower grade $15.41. The cost to consumers in the United States also includes duty, loading charges,

[6] Duncan, W. F., Concentrating Operations of the Mahoning Mining Co., Rosiclare, Ill.: Am. Inst. Min. and Met. Eng. Tech. Pub. 2040, 1946, 14 pp.

[7] Fine, M. N. and O'Meara, R. G., Laboratory Beneficiation of Fluorite Ore from the Minerva Oil Co., Eldorado, Ill.: Am. Inst. Min. and Met. Eng. Tech. Pub. 2055, 1946, 10 pp.

[8] As defined in sec. 402 of the tariff act of 1930: "The value of imported merchandise * * * is the foreign value or the export value, whichever is higher—that is, the market value or the price at which the merchandise, at the time of exportation to the United States, is offered for sale in the principal markets of the country from which exported, including the cost of containers or coverings and all expenses (including any export tax) incident to placing the merchandise in condition ready for shipment to the United States."

insurance, consular fee, and freight to consuming plants. The duty on fluorspar containing not more than 97 percent calcium fluoride continued at $5.625 a short ton and on fluorspar containing more than 97 percent calcium fluoride $3.75.

Unlike in 1943, 1944, and 1945, when the bulk of the imported fluorspar was delivered to Government stock piles, all foreign fluorspar received in 1946 was for use by domestic consumers.

Fluorspar imported for consumption in the United States in 1946, by countries of origin and United States customs districts of entry

Country and customs district	Containing more than 97 percent calcium fluoride		Containing not more than 97 percent calcium fluoride		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Canada: Buffalo			310	$8,934	310	$8,934
Mexico:						
Arizona			3,003	44,275	3,003	44,275
Chicago			1,033	15,584	1,033	15,584
El Paso	51	$750	2,379	23,021	2,430	23,771
Laredo	3,882	77,469	13,367	217,461	17,249	294,930
Michigan			272	4,438	272	4,438
New York			14	98	14	98
St. Louis			62	1,661	62	1,661
	3,933	78,219	20,130	306,538	24,063	384,757
Newfoundland: Philadelphia	2,688	80,640			2,688	80,640
Spain: Philadelphia			2,791	42,484	2,791	42,484
Total: 1946	6,621	158,859	23,231	357,956	29,852	516,815
1945	10,275	254,800	92,858	1,901,658	103,133	2,156,458

The accompanying table, compiled from data supplied the Bureau of Mines by importers and by domestic companies milling foreign fluorspar, shows the quantities of imported fluorspar delivered to consumers in the United States in 1945 and 1946, irrespective of year of importation into the United States; it differs from the preceding table, which shows the quantity and grade imported into the United States in 1945 and 1946. The quantities in the accompanying table are based upon the actual outturn weights and include the finished fluorspar recovered from milling foreign ore and from drying filter cake, rather than the ore milled or wet filter cake.

Imported fluorspar delivered to consumers in the United States, 1945–46, by uses

Use	1945			1946		
	Short tons	Selling price at border, tidewater, or f. o. b. flotation mill in United States, including duty		Short tons	Selling price at border, tidewater, or f. o. b. flotation mill in United States, including duty	
		Total	Average		Total	Average
Steel	21,027	$555,530	$26.42	20,319	$485,592	$23.90
Hydrofluoric acid	22,579	811,025	35.92	5,143	163,659	31.82
Magnesium	60	2,100	35.00			
Ferro-alloys	193	5,769	29.89	309	10,700	34.63
Glass and enamel	548	18,110	33.05	106	3,384	31.92
Other	125	4,625	37.00	186	4,238	22.78
	44,532	1,397,159	31.37	26,063	667,573	25.61

Exports.—Producers of fluorspar reported exports of 1,729 short tons of fluorspar valued at $63,797 in 1946 compared with 1,420 tons valued at $45,939 in 1945. The exports (all ceramic ground and flotation concentrates) by producers in 1946 comprised 700 tons to Canada; 480 tons to Peru; 496 tons to Belgium; 42 tons to Mexico; and 11 tons to Uruguay.

Fluorspar reported by producers as exported from the United States, 1942–46

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1942	9,016	$242,545	$26.90	1945	1,420	$45,939	$32.35
1943	9,044	246,973	27.31	1946	1,729	63,797	36.90
1944	1,980	65,909	33.29				

WORLD REVIEW

The accompanying table shows world production of fluorspar, by countries, in 1937, 1939, and 1942 to 1946, insofar as statistics are available.

World production of fluorspar, 1937, 1939, and 1942–46, by countries, in metric tons [1]

[Compiled by B. B. Mitchell]

Country [1]	1937	1939	1942	1943	1944	1945	1946
Argentina (shipments)	350	739	2,328	4,000	(2)	(2)	(2)
Australia:							
New South Wales	55						(2)
Queensland	1,410	20	311	544	520	801	875
Victoria			344	468	266	145	326
Canada	136	218	5,624	10,169	6,281	6,685	6,853
France	51,430	(3)	27,447	24,160	13,400	13,749	21,528
Germany:							
Anhalt	13,662	11,157	12,470				
Baden	13,637	22,480	31,625				
Bavaria	62,455	69,870	59,640	[3] 190,000	[3] 170,000	(2)	(2)
Prussia	30,514	24,414	27,841				
Saxony	8,074	10,002	11,806				
Thuringia	16,117	24,040	32,290				
India		20	4,110	1,667	1,249	(2)	(2)
Italy	13,385	13,243	35,034	(2)	(2)	(2)	(2)
Japan	(2)	1,960	7,800	7,282	7,967	3,207	(2)
Korea (Chosen)	8,084	[3] 22,000	47,847	[3] 50,000	[3] 60,000	(2)	(2)
Mexico (exports)	(2)		5,365	22,469	56,450	50,251	20,114
Newfoundland	8,479	11,227	[3] 32,660	66,170	58,290	49,841	[4] 25,266
Norway	1,692	2,411	1,920	905	3,119	(2)	(2)
Southern Rhodesia			(2)	(2)	(2)	(2)	(2)
South-West Africa		105	(2)	(2)	(2)		(2)
Spain	4,250	8,408	16,297	35,911	55,595	9,642	[5] 6,477
Sweden	(2)		468	2,107	1,836	3,448	(2)
Switzerland			486	582	520		(2)
Tunisia	1,676	2,010	(3)	16			(2)
Union of South Africa	3,615	10,322	4,185	4,646	3,481	3,657	4,004
U. S. S. R.	[3] 70,000	(2)	(2)	(2)	(2)	(2)	(2)
United Kingdom	42,837	38,786	43,920	55,106	48,927	44,281	46,644
United States (shipments)	164,408	165,806	326,871	368,330	375,374	293,891	252,142
Total (estimate)	519,000	577,000	883,000	1,022,000	1,086,000	(2)	(2)

[1] In addition to countries listed China produces fluorspar, but data of output are not available.
[2] Data not available.
[3] Estimate.
[4] Exports.
[5] January to September, inclusive.

Canada.—According to the Dominion Bureau of Mines, production of fluorspar in Canada was 6,853 metric tons [9] (all from Ontario) in

[9] 1 metric ton is equivalent to 1.10231 short tons.

1946 compared with 6,685 tons in 1945. In Canada output falls short of consumption, and the greater part of the deficiency is met by importations, chiefly from Mexico, Newfoundland, and the United States. However, small quantities of metallurgical-grade fluorspar are exported from Canada to the United States. Imports into Canada were 24,279 metric tons during the first 10 months of 1946 compared with 18,608 tons in the entire year 1945.

Mexico.—Chiefly as a result of demand by the United States, production of fluorspar (as measured by exports) in Mexico increased from an average of 11,907 metric tons annually during the 4 years 1940–43 to 56,450 and 50,251 tons, respectively, in 1944 and 1945. Exports in 1946 declined to 20,114 metric tons. Some Mexican fluorspar is used in local steel plants, and some is also exported to Canada.

Newfoundland.—The St. Lawrence Corp. of Newfoundland, Ltd., which has a gravity-concentrating mill and a flotation mill for treating ore from its mines, was the only producer of fluorspar in Newfoundland in 1946. Shipments were 11,617 metric tons in 1946 compared with 19,890 tons in 1945. Shipments were made to the United States and Canada. The product shipped to the United States in 1946 was acid-grade filter cake; a plant for drying it was completed in late 1946 at Wilmington, Del., by St. Lawrence Fluorspar, Inc., an affiliate of the St. Lawrence Corp. of Newfoundland, Ltd.

The mines of Newfoundland Fluorspar, Ltd. (a subsidiary of the Aluminum Co. of Canada, Ltd.), were not in production in 1946, but general prospecting and the required assessment work were done on various mineral claims held by the company. However, from a stock pile at its Director mine 13,103 metric tons of crushed fluorspar were shipped to Arvida, Quebec, and 546 metric tons were exported to Finland. The company is resuming development at its Tarefare mine in 1947.

CRYOLITE

Imports of cryolite were 10,200 long tons valued at $815,627 in 1946 compared with 17,952 tons valued at $1,349,678 in 1945. Except for 2 tons from Canada in 1945, the cryolite imported in 1946 and 1945 came from Greenland.

Exports of cryolite were 1,160 long tons valued at $285,110 in 1946 compared with 1,697 tons valued at $420,592 in 1945.

Cryolite occurs in commercial quantity and is mined at only one place—Ivigtut, Greenland. Gibbs [10] has described the mine at Ivigtut, the grades of ore produced, methods of processing and purification, and various uses of cryolite.

Artificial cryolite was manufactured in the United States in 1946 by the Aluminum Ore Co. at East St. Louis, Ill., and the Reynolds Metals Co., at Bauxite (Hurricane Creek), Ark.

The chief use of cryolite is in the reduction of aluminum; comparatively small quantities are used in glass, enamels, abrasives, and insecticides.

[10] Gibbs, A. E. (technical director, Pennsylvania Salt Manufacturing Co.), Cryolite as a Chemical Raw Material: Chem. Ind., vol. 38, May 1936, pp. 471–476.

Fuel Briquets and Packaged Fuel[1]

By GERTRUDE S. GOODMAN

	PAGE
General summary	525
Fuel briquets	526
Salient statistics	527
Production	527
Number of plants	529
Capacity	529
Raw fuels	530
Binders	532
Weight and shape	533
Shipments	533
Value	534
Foreign trade	535
Fuel briquets—Continued.	
Technologic developments	535
World production	536
Packaged fuel	537
Salient statistics	538
Production	538
Value of production	540
Number of plants	540
Capacity	541
Processes	541
Raw fuels	542
Binders	543

GENERAL SUMMARY

THE FUEL-BRIQUETTING industry has continued steady expansion of its production since 1938, exceeding 3,000,000 net tons in 1946. Packaged-fuel production dropped to 191,000 tons in 1946 from a peak of 285,000 tons in 1940.

The fuel-briquetting industry consists of a relatively few large plants (35 with an average annual output of 86,000 tons in 1946), producing a small, hard pillow-briquet suitable for shipment. The packaged-fuel industry consists of a larger number of small plants (70 with an average annual output of 2,700 tons in 1946), producing 3- to 4-inch, more or less friable cubes wrapped (6 or 8 to the package) in sturdy paper, suitable for local consumption but not as a rule for transportation over long distances. There are, however, some considerably larger plants in both the briquetting and in the packaged-fuel industries.

In 1940, packaged fuel amounted to 27 percent of the fuel-briquet production; by 1946 it had declined to 6 percent. The relative production of the two industries in the United States from the first year of record through 1945 is shown graphically in figure 1. The profound business depression in the early thirties and the increased

[1] Briquets made from charcoal, wood scrap, and fruit pits not included in Bureau of Mines review.

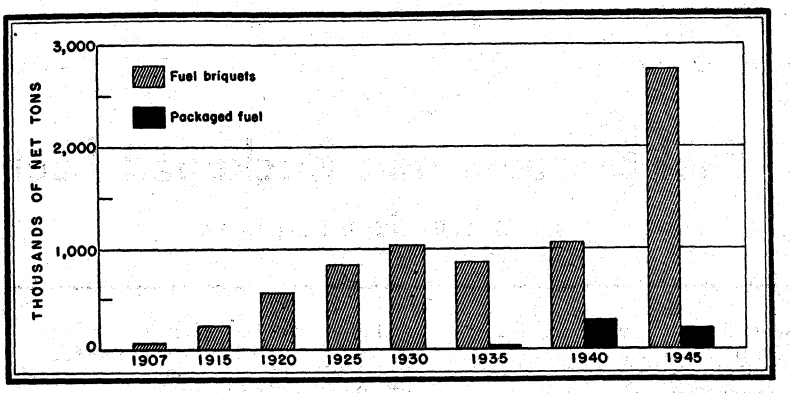

FIGURE 1.—Production of fuel briquets and packaged fuel in the United States from the first year of record to 1945.

fuel demands of World War II are reflected in the production of fuel briquets in the graph. The packaged-fuel industry, which had its inception about 1928 but has been canvassed only since 1935, rose spectacularly from 1935 to its peak in 1940, but war shortages and high costs of labor, raw fuels, and critical materials have since retarded its growth.

The total supplies of solid fuels commonly used for space heating in the United States in 1946 (see Coal—Pennsylvania Anthracite chapter of this volume, table 25) in order of their importance were as follows: Bituminous coal (including lignite) exact tonnage not available; Pennsylvania anthracite, 58,500,000 tons; coke (all kinds), 7,600,000; fuel briquets, 2,800,000; and packaged fuel, 191,000.

Wartime controls on solid fuels have ended. All allocation functions of the Solid Fuels Administration for War were terminated with the expiration of the applicable provisions of the Second War Powers Act March 31, 1947; all other SFAW functions were terminated by Executive order on May 6, 1947. All remaining price ceilings still in effect were lifted by the Office of Price Administration on November 10, 1946. All priority and urgency certificate assistance to obtain machinery for industry was discontinued January 8, 1947, by the Office of Temporary Controls (successor to Civilian Production Administration).

FUEL BRIQUETS

Salient statistics of the fuel-briquetting industry from 1942 to 1946 are summarized in table 1. Production and value from 1917 to 1946, inclusive, are shown graphically in figure 2.

TABLE 1.—Salient statistics of the fuel-briquetting industry in the United States, 1942–46

Year	Production				Imports	Exports
	Eastern States	Central States	Pacific Coast States	Total		
	Net tons					
1942	565,675	1,047,747	134,878	1,748,300	334	103,921
1943	544,786	1,493,368	125,844	2,163,998	198	174,973
1944	625,779	1,704,005	135,177	2,464,961	538	163,672
1945	637,740	1,991,733	132,731	2,762,204	722	174,107
1946	880,109	1,986,234	137,684	3,004,027	653	163,339

Year	Apparent consumption [1] (net tons)	Value of production	Plants in operation	Average value per net ton, f. o. b. plant		
				Eastern States	Central States	Pacific Coast States
1942	1,644,713	$11,266,041	30	$4.56	$7.04	$9.69
1943	1,989,223	15,148,109	28	5.04	7.44	10.26
1944	2,301,827	18,434,579	30	5.42	8.03	10.07
1945	2,588,819	21,678,886	32	5.65	8.40	10.04
1946	2,841,341	25,299,612	35	6.61	9.03	11.26

[1] Production plus imports minus exports.

PRODUCTION

The output of fuel briquets in 1946, rising steadily since 1938, reached a new high of 3,004,027 tons, valued at $25,299,612—a 9-percent increase in tonnage and a 17-percent increase in value over 1945. The increase was greatest in the Eastern States region (see table 2).

Briquets were made in 15 States in 1946, with production centered in Wisconsin (leading with 1,511,670 tons), followed by Pennsylvania, West Virginia, and Missouri, in that order. Production cannot be shown by States without revealing the operations of individual plants, except for Wisconsin, Pennsylvania, and Illinois, as there were less than 3 plants in each of the other 12 producing States. Production in Wisconsin in 1946, topping all previous years, increased 2 percent in quantity, with an increase of 7 percent in value over 1945. The 4 plants in Pennsylvania produced 469,958 tons, valued at $3,329,494 (a 65-percent increase in production and 97-percent increase in value over 1945); the large increase is due to the beginning of operations at 2 new plants of the Reading Briquet Co. at Locust Summit and St. Nicholas. Production at 3 plants in Illinois in 1946 amounted to 108,045 tons, valued at $569,200 (a decrease of 8 percent in production but an increase of 11 percent in value over 1945).

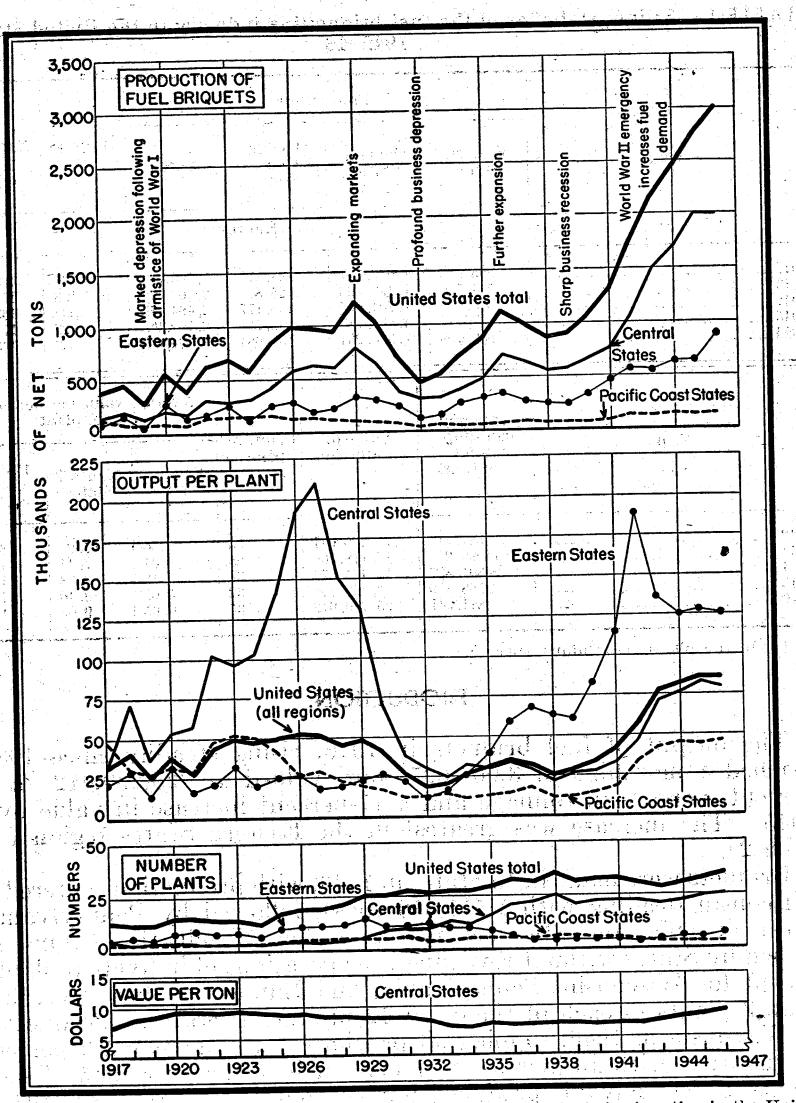

FIGURE 2.—Production of fuel briquets, output per plant, number of plants in operation in the United States (by regions), and average value per net ton, f. o. b. plant (Central States), 1917–46.

At the six new plants briquetting machinery was installed by the Briquetting Machinery Co., Rutherford, N. J. (one plant); Komarek-Greaves & Co., Chicago, Ill. (two plants); National Engineering Co., Girard, Kans. (one plant); and the Webb Corp., Webb City, Mo. (two plants). Three plants reported installation of additional machinery in 1946.

In 1946, 17 of the 35 active plants operated each month throughout the year. According to the Weather Bureau,[2] the winter of 1946

[2] Baldwin, J. L., The Weather of 1946 in the United States: U. S. Department of Commerce Monthly Weather Review, vol. 74, No. 12, December 1946, pp. 205–209

was unusually mild, the temperatures averaging higher than usual over practically the entire country, except in California and Oregon.

TABLE 2.—Production of fuel briquets in the United States, 1945–46

	1945			1946				
	Plants [1]	Net tons	Value	Plants [1]	Net tons	Value	Percent of change from 1945 in—	
							Tonnage	Value
Eastern States	5	637,740	$3,606,372	7	880,109	$5,817,639	+38.0	+61.3
Central States	24	1,991,733	16,739,912	25	1,986,234	17,931,641	−.3	+7.1
Pacific Coast States	3	132,731	1,332,602	3	137,684	1,550,332	+3.7	+16.3
	32	2,762,204	21,678,886	35	3,004,027	25,299,612	+8.8	+16.7

[1] 1945: 11 plants in Wisconsin; 3 each in Illinois and Missouri; 2 each in Michigan, Pennsylvania, and West Virginia; and 1 each in Arkansas, California, Massachusetts, Minnesota, Nebraska, North Dakota, Oregon, Washington, and Wyoming. 1946: 11 plants in Wisconsin; 4 plants in Pennsylvania; 3 in Illinois; 2 each in Arkansas, Kansas, Michigan, Missouri, and West Virginia; and 1 each in California, Massachusetts, Minnesota, Nebraska, North Dakota, Oregon, and Washington.

Number of Plants.—Thirty-five plants reported production in 1946; 29 of these were also active in 1945.[3] The 6 new briquetting plants which started commercial operations in 1946 were 2 plants of the Reading Briquet Co., Locust Summit and St. Nicholas, Pa.; Fort Scott Briquette Co., Inc., Fort Scott, Kans.; Acme Briquets, Inc., Kansas City, Kans.; Universal Briquet Co., Fort Smith, Ark.; and United Ice & Fuel Co., Flint, Mich. Two additional briquetting plants were reported under construction in 1946 to start operation in 1947—De Angelis Coal Co., Buena Vista, Calif. (utilizing California lignite), and Lake Coal Co., Inc., Syracuse, N. Y. (utilizing Pennsylvania anthracite). Of the 6 plants idle in 1946, 3 were active in 1945. Three plants went out of business in 1946.

Capacity.—The average annual capacity and average annual production per plant in the briquetting industry in the United States, by regions, in 1946, were as follows:

	Average capacity (net tons)	*Average production (net tons)*
Eastern States (7 plants)	220,000	126,000
Central States (25 plants)	114,000	79,000
Pacific Coast States (3 plants)	48,000	46,000
Total United States (35 plants)	130,000	86,000

Annual capacities of 100,000 tons or more were reported by 6 out of 7 plants in the Eastern States, by 9 out of 25 in the Central States, and by 1 out of 3 in the Pacific Coast States. The largest annual capacities as well as the largest productions in 1946 were reported by the Berwind Fuel Co. and the Stott Briquet Co., Inc., for their plants at Superior, Wis. Table 3 gives comparative data for the past 10 years on capacity and relative production for the United States as a whole and reveals the increase in utilization of the total capacity of the active briquetting plants during the recent war years, amounting to 66 percent in 1946.

[3] Years plants (active in 1946) started producing are given in the 1946 Fuel-Briquet Directory (which also shows type of raw fuels used), obtainable on request from the Bureau of Mines, Washington 25, D. C.

TABLE 3.—Annual capacity and production of briquetting plants in the United States, 1937–46

	Active plants		Production		
	Number	Annual capacity (net tons)	Net tons	Percent of—	
				Annual capacity	Annual production
1937	31	3,423,000	995,930	29.1	100.0
1938	35	3,112,000	871,260	28.0	100.0
1939	31	3,161,000	892,213	28.2	100.0
1940	32	3,082,000	1,050,870	34.1	100.0
1941	32	3,100,000	1,298,606	41.9	100.0
1942	30	3,199,000	1,748,300	54.7	100.0
1943	28	3,164,000	2,163,998	68.4	100.0
1944	30	3,493,900	2,464,961	70.6	100.0
1945	32	3,782,900	2,762,204	73.0	100.0
1946:					
Capacity of—					
Less than 5,000 tons	1	102,500	42,139	41.1	1.4
5,000 to less than 10,000	1				
10,000 to less than 25,000	6				
25,000 to less than 100,000	[1] 11	542,400	183,625	33.9	6.1
100,000 to less than 200,000	7	828,400	695,906	84.0	23.2
200,000 to less than 400,000	6	1,560,000	1,001,604	64.2	33.3
400,000 or more	3	1,500,000	1,080,753	72.1	36.0
	35	4,533,300	3,004,027	66.3	100.0
Production of—					
Less than 2,000 tons	3	111,400	9,127	8.2	.3
2,000 to less than 5,000	2				
5,000 to less than 10,000	[2] 6	192,000	43,992	22.9	1.5
10,000 to less than 25,000	5	201,500	86,836	43.1	2.9
25,000 to less than 100,000	8	890,000	544,768	61.2	18.1
100,000 or more	11	3,138,400	2,319,304	73.9	77.2
	35	4,533,300	3,004,027	66.3	100.0

[1] 4 of these plants started operations in last half of 1946.
[2] 3 of these plants started operations in last half of 1946.

Raw Fuels.—Table 4 shows the wide variety of raw fuels used in the manufacture of fuel briquets in 1946, and table 5 the types of briquets made from these fuels. The major raw fuels used are bituminous coal and Pennsylvania anthracite; the former, however, has decreased in the past 5 years from 65 percent of the total raw fuel used in 1942 to 45 percent in 1946, while the use of Pennsylvania anthracite has risen in this same period from 16 percent (used at 5 plants) in 1942 to 39 percent (at 15 plants) in 1946. The increased use of anthracite in the past 3 years is traceable to the program inaugurated in 1944 by the Solid Fuels Administration for War[4] for wider utilization of surplus anthracite fines when bituminous coal was in short supply; subsequently, many operators began combining considerable quantities of anthracite fines with bituminous coal. The resulting high-quality briquet, representing the major portion of the fuel briquets made in the United States since 1943, has been favorably received and is generally retailed for less than space-heating sizes of Pennsylvania anthracite (except buckwheat No. 1) in localities where both are available to the consumer.

In the Eastern States region, bituminous coal and anthracite fines were the raw fuels used by the plants near mines in West Virginia and Pennsylvania in 1946; and in the Central States region—with plants

[4] Solid Fuels Administration for War, P. N. 71018, SFA 254, Sept. 5, 1944.

in nine States and production concentrated in the Lake Dock territory—all the fuels except the residual carbons were used, their type depending upon their availability at the point of manufacture. In the Pacific coast region, the residual carbons from the manufacture of oil gas and the pyrolysis of natural gas were the raw fuels used in briquetting operations.

The most outstanding gain in the output of briquets in 1946 over 1945 occurred at plants near coal mines in the Eastern States, traceable to the additional output of the two new Reading Briquet Co. plants at Locust Summit and St. Nicholas, Pa.

TABLE 4.—Raw fuels used in making fuel briquets in the United States, 1946

Character of raw fuels used	Plants	Net tons	Plants using—	Plants	Raw fuels used (net tons)		
					Yard screenings	Other raw fuels	Total
Pennsylvania anthracite	15	1,098,999	Yard screenings exclusively (from own or other yards)	3	12,927		12,927
Arkansas hard coals	8	[1] 275,245					
Bituminous (low-volatile)	17	1,166,043					
Bituminous (high-volatile)	4	119,356	Raw fuels (other than yard screenings) exclusively	21		1,517,103	1,517,103
Semicoke (lignite char)	1						
Residual carbon from pyrolysis of natural gas	1	153,900					
Residual carbon from manufacture of oil gas	2		Both yard screenings and other raw fuels	11	272,711	1,025,855	1,298,566
Petroleum coke	3	15,053					
	[2] 35	2,828,596		35	285,638	2,542,958	2,828,596

[1] Includes relatively small tonnage of Oklahoma semianthracite.
[2] 17 plants used 1 kind of fuel only, 2 plants used 2 kinds (separately), and 16 used mixtures of 2 kinds; hence the sum of the items shown exceeds the total number of plants.

TABLE 5.—Classification of plants and production of fuel briquets in the United States, by kinds of raw fuel used, 1945–46

Raw fuel used	1945			1946		
	Plants	Briquets produced		Plants	Briquets produced	
		Net tons	Percent of total		Net tons	Percent of total
Pennsylvania anthracite	2			2		
Mixture of Pennsylvania anthracite and bituminous (low-volatile)	10	1,765,769	63.9	11	1,983,238	66.0
Mixture of Pennsylvania anthracite and bituminous (high-volatile)				2		
Semianthracite	4	303,423	11.0	6	296,968	9.9
Arkansas hard coals mixture	1			[1] 2		
Bituminous:						
Low-volatile	8	510,565	18.5	6	540,844	18.0
High-volatile	2			1		
Semicoke (lignite char)	1			1		
Residual carbon from pyrolysis of natural gas	1	156,448	5.7	1	166,715	5.6
Residual carbon from manufacture of oil gas	2			2		
Petroleum coke	4	25,999	.9	2	16,262	.5
Mixture of petroleum coke and bituminous (high-volatile)				1		
	[2] 32	2,762,204	100.0	[2] 35	3,004,027	100.0

[1] One of these plants also used a relatively small tonnage of Oklahoma semianthracite.
[2] In 1945, 3 plants made 2 kinds of briquets; in 1946, 2 plants made 2 kinds; hence the sum of the items shown exceeds the total number of plants active in the respective years.

TABLE 6.—Production of fuel briquets, grouped according to location of plants with reference to supply of raw fuel, 1945–46

Location of plant	1945		1946		Change in 1946	
	Plants	Production (net tons)	Plants	Production (net tons)	Net tons	Percent
Near Lake coal docks:						
Lake Superior	4	1,069,868	4	1,091,580	+21,712	+2.0
Lake Michigan	8	453,597	8	454,314	+717	+.2
Lake Huron	1		1			
	13	1,523,465	13	1,545,894	+22,429	+1.5
Near coal mines:						
Eastern States	4	637,353	6	879,463	+242,110	+38.0
Central States	7	430,487	9	402,091	−28,396	−6.6
	11	1,067,840	15	1,281,554	+213,714	+20.0
Near petroleum refineries and oil- and natural-gas plants:						
Central States	2	162,543	1	164,481	+1,938	+1.2
Pacific Coast States	3		3			
	5	162,543	4	164,481	+1,938	+1.2
Other locations:						
Eastern States	1	8,356	1	12,098	+3,742	+44.8
Central States	2		2			
	[1] 3	8,356	[2] 3	12,098	+3,742	+44.8
Total United States	32	2,762,204	35	3,004,027	+241,823	+8.8

[1] Fall River, Mass.; Jackson, Mich.; and Omaha, Nebr.
[2] Fall River, Mass.; Flint, Mich.; and Omaha, Nebr.

Binders.—Asphalt binders remain the preferred type in briquetting coal and coke and were used exclusively by 30 plants that produced 92 percent of the fuel briquets made in 1946. Three other plants used, respectively, asphalt and coal-tar pitch combined, asphalt and starch combined, and oil-gas tar pitch. In 1946, 2 plants used no binder; 1 of these briquetted the carbon residue from the manufacture of oil gas, and 1 used low-volatile bituminous coal (the latter has been in operation since 1936 and the entire production, relatively small, is consumed locally).

TABLE 7.—Classification of briquetting plants in the United States, 1945–46, by percentage of binder used

Percent of binder in briquet (by weight)	1945			1946		
	Plants	Production		Plants	Production	
		Net tons	Percent of total briquets		Net tons	Percent of total briquets
No binder	[1] 3	119,000	4.3	[1] 2	141,352	4.7
Less than 5 percent	4	41,333	1.5	3		
5 to less than 7 percent	16	2,083,292	75.4	16	2,180,090	72.6
7 to less than 9 percent	6	475,799	17.2	9	620,287	20.6
9 percent or more	3	42,780	1.6	5	62,298	2.1
	32	2,762,204	100.0	35	3,004,027	100.0

[1] In 1945, 2 plants used residual carbon from manufacture of oil gas and 1 used bituminous coal as raw fuel; in 1946, 1 used residual carbon from manufacture of oil gas and 1, bituminous coal.

Operators reported approximately 181,000 tons of asphaltic types and small quantities of starch, coal-tar pitch, and oil-gas tar pitch used as binders in 1946 in the manufacture of fuel briquets.

Seventy-three percent of the total production of fuel briquets in 1946 was made with binders ranging from 5 to 7 percent (percent of binder in briquet—by weight), as compared with 31 percent of the production in 1942, 38 percent in 1943, 70 percent in 1944, and 75 percent in 1945.

Weight and Shape.—Pillow-shaped briquets weighing less than 5 ounces (except for an 11-ounce, high-volatile bituminous pillow made by Coal Processing Corp., Buckner, Ill.) were made at 32 plants in 1946 and comprised approximately 77 percent of the total production. Cylindrical (barrel-shaped) briquets were made at 2 plants and 18- and 20-ounce cubes at 1 plant. Briquets weighing under 3 ounces represented 62 percent of the total production in 1946.

SHIPMENTS

In 1946 fuel briquets were shipped to 35 States and the District of Columbia and exported principally to Canada. States reporting the largest output in 1946 shipped their briquets as follows: From Wisconsin to 8 States and Canada; from Pennsylvania to 24 States, the District of Columbia, and Canada; and from West Virginia to 19 States, the District of Columbia, and Canada.

Shipments from each producing State cannot be shown because there are only one or two producers in each of the States except Wisconsin, Pennsylvania, and Illinois, and confidential data of individual operations would thus be revealed. However, a graphic presentation of the centers of production, with corresponding States of destination for 1936, was included in Minerals Yearbook, 1937, page 965; and since then markets have been extended still farther, particularly in the New England and other Eastern States.

TABLE 8.—Shipments of fuel briquets of domestic manufacture in the United States, 1945–46, by States of destination, as reported by producers, in net tons [1]

State of destination	1945	1946	State of destination	1945	1946
Arkansas	540	438	New Hampshire	3,868	10,686
California	15,343	11,577	New Jersey	16,241	27,734
Connecticut	7,738	15,302	New York	66,731	94,124
Delaware	3,147	3,537	North Carolina	13,985	19,080
District of Columbia	1,606	2,159	North Dakota	145,401	157,482
Florida	615	544	Ohio	53,385	74,391
Georgia	152	200	Oregon	89,901	95,688
Illinois	92,143	113,082	Pennsylvania	52,247	49,498
Indiana	47,321	63,552	Rhode Island	7,100	8,249
Iowa	150,815	124,271	South Carolina	4,057	5,723
Kansas	15,384	13,931	South Dakota	139,399	132,348
Kentucky	5,149	4,939	Vermont	1,697	5,864
Maine	11,155	17,924	Virginia	19,687	24,811
Maryland	10,028	21,049	Washington	7,709	6,923
Massachusetts	51,153	63,458	West Virginia	1,476	2,708
Michigan	131,455	187,452	Wisconsin	535,883	543,692
Minnesota	551,855	579,356	Wyoming	29	
Mississippi		97			
Missouri	276,471	245,903		2,585,091	2,784,662
Nebraska	54,225	56,890			

[1] For shipments outside the United States see export statistics, table 10.

The difference between production in 1946 (3,004,027 tons) and shipments within the United States (2,784,662) represents briquets exported, used at plants for power or heat, and variation in year-end stocks. Fuel briquets are used almost entirely for domestic space heating, but seven operators reported a total of 30,585 tons used for power or heat at their plants in 1946.

TABLE 9.—Direct shipments of fuel briquets by rail and truck, as reported by producers, 1945–46, in net tons [1]

Produced in—	1945			1946		
	Rail	Truck	Total	Rail	Truck	Total
Eastern States	617,222	19,558	636,780	860,786	19,463	880,249
Central States	1,606,405	380,581	1,986,986	1,617,462	475,753	1,979,027
Pacific Coast States	24,315	88,638	112,953			114,188
Total United States	2,247,942	488,777	[2] 2,736,719	2,478,248	495,216	[2] 2,973,464

[1] Includes shipments outside the United States.
[2] An additional 20,139 tons were used by 2 producers as fuel at their plants in 1945 and 30,585 tons by 7 producers in 1946.

VALUE

The total sales value of the fuel briquets manufactured in 1946 was $25,299,612 f. o. b. plant—an increase of $3,620,726 or 17 percent over 1945 (table 2).

As sales realizations on briquets in the scattered producing centers vary considerably, an average value per ton for the entire industry has doubtful significance, because of the different conditions under which briquets are manufactured and sold. The most important factors that influence the value per ton realized at any plant are cost of raw materials and labor and prices of competing fuels; hence, the trend of fuel-briquet values is indicated best in this review by the average values in the Eastern, Central, and Pacific Coast States (table 1 and figure 2). These are the values received by producers for the total product at the plant and should not be confused with retail prices, which may include transportation costs to markets and wholesalers' margins.

The average value per ton, f. o. b. plant, for the Eastern States in 1946 was $6.61, compared with $9.03 for the Central States and $11.26 for the Pacific Coast States. In the Eastern States nearly all the output comes from plants in the low-volatile coal fields of southern West Virginia and in the anthracite region of Pennsylvania, where the cost of raw fuel does not involve freight charges; as a result, the value f. o. b. plant is relatively low. In the Central States 78 percent of the production comes from plants at coal docks on the Great Lakes; the raw fuel for these plants involves a considerable freight charge, which is reflected in the higher value per ton f. o. b. plant. In the Pacific Coast States (representing but 5 percent of the national production in 1946), the average value per ton represents the highest value f. o. b. plant for fuel briquets in the United States.

FOREIGN TRADE[5]

Imports of briquets into the United States in 1946 totaled 653 tons valued at $4,486; all came from Canada. Exports of fuel briquets, principally to Canada, amounted to 163,339 tons, 4 percent less than in 1945.

TABLE 10.—Briquets (coal and coke) exported from the United States, 1945–46, by countries of destination and customs districts

	1945		1946	
	Net tons	Value	Net tons	Value
COUNTRY				
Canada	157,789	$1,126,233	163,305	$1,355,869
Cuba	4	100	23	500
Dominican Republic			1	60
France	895	5,200		
Mexico	10	176	8	194
Panama, Republic of			2	35
Switzerland	10,662	122,522		
	169,360	1,254,231	163,339	1,356,658
CUSTOMS DISTRICT				
Arizona	4	97		
Buffalo	25,080	149,652	41,871	381,445
Dakota	29,398	234,003	20,071	175,300
Duluth and Superior	10,062	80,555	34,428	312,266
Florida	4	100	22	500
Laredo	4	67		
Maine and New Hampshire	85	495	934	6,385
Michigan	67,727	468,446	40,502	252,523
New Orleans			2	35
Philadelphia	11,557	127,722		
Puerto Rico			1	60
Rochester	4,085	20,580	15,859	130,859
St. Lawrence	21,338	172,434	6,302	62,315
San Diego	1	12	8	194
Vermont	15	68	3,302	34,307
Washington			37	469
	169,360	1,254,231	163,339	1,356,658

TECHNOLOGIC DEVELOPMENTS

A plan to use Pennsylvania anthracite fines was sponsored by the Federal Government at the request of the Solid Fuels Administration for War[6] in 1944. Extensive experiments were made by the Bureau of Mines[7] to test the possibilities of the use of small anthracite as follows:

(*a*) The burning of mixtures of small anthracite and bituminous slack on stokers.

(*b*) Methods of producing and burning "packaged fuel" made from anthracite fines.

(*c*) The use of anthracite fines in the production of coke.

(*d*) The use of barley anthracite in gas producers.

[5] Figures on imports and exports compiled by M. B. Price of the Bureau of Mines, from records of the U. S. Department of Commerce.

[6] Solid Fuels Administration for War, P. N. 71018, SFA 254, Sept. 5, 1944.

[7] Barkley, J. F., and Seymour, William, War Problem of Increasing Utilization of Small Anthracite: Mech. Eng., vol. 67, No. 7, July 1945, pp. 457–462.

Schmidt, L. D., Reid, W. T., Seymour, William, and Myers, J. W., Physical and Combustion Characteristics of Packaged Fuel Containing Anthracite Fines: Bureau of Mines Rept. of Investigations 3882, 1946, 35 pp.

Saward's Journal, Packaged Fuel—Bureau of Mines Study Indicates Marketing Possibilities Are Encouraging: Vol. 29, No. 13, June 29, 1946, p. 175.

In connection with the acute shortage of coal in Alaska, the Bureau of Mines during the war cooperated with the Coal Procurement Section, Alaska Department, United States Army, in investigating the possibilities of briquetting the subbituminous and lignite coals of Healy Creek Valley, Alaska, to make them suitable for stock piling and transshipment to the Aleutian bases. Tests indicated that satisfactory briquets could be obtained with the addition of one-third coking coal from the Matanuska district.[8]

In 1943 and 1944 the Bureau of Mines, in cooperation with the University of North Dakota, Grand Forks, N. Dak., and the Colorado School of Mines, Golden, Colo., made tests on lignite-char briquets which revealed that they were not suitable for gasification in the standard water-gas process because of disintegration and low efficiency caused by loss of fine carbon.[9]

The Illinois Geological Survey at Urbana continued experimental work during 1946 on the briquetting of Illinois coals by the Piersol[10] process and press, at room temperature without the addition of binder, at approximately 30,000 pounds pressure per square inch, followed by heat treatment at about 360° C. for various periods to determine the effect upon smokelessness, firmness, and weather resistance.

WORLD PRODUCTION

Table 11 includes official data received since the close of the war on the production of fuel briquets in other countries and now presents a fairly complete picture for 1939 to 1944, inclusive. During this period production in Germany—the principal briquet-producing country of the world—rose 31 percent; output in the United States more than doubled; but production dropped appreciably in the other larger briquet-producing countries—France, Netherlands, and Belgium. The United States, which ranked as fifth largest producer in 1939, was second largest in 1944.

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[8] Marstrander, H., Apell, G. A., Rutledge, F. A., and Hulbert, J. H., Exploration of Leasing Block No. 28 in the Nenana Coal Field, Alaska: Bureau of Mines Rept. of Investigations 3951, 1946, p. 21.
Office of the Quartermaster General, United States Army, Preliminary Investigation of Briquetting Plant for and the Briquetability of Alaska Coals: Solid Fuels Branch, Fuels and Lubricants Division, February 20, 1944, p. 3.

[9] Parry, V. F., and others, Gasification of Lignite and Subbituminous Coal: Bureau of Mines Rept. of Investigations 3901 (part III, Gasification of Lignite Char Briquets in a Water-Gas Machine), 1946, 59 pp.

[10] Piersol, R. J., Briquetting Illinois Coals Without a Binder by Compression and Impact: Illinois State Geol. Survey Rept. of Investigations 31, 1933, 70 pp.; Briquetting Illinois Coals Without a Binder by Impact: Illinois State Geol. Survey Rept. of Investigations 37, 1935, 75 pp.; Smokeless Briquets: Impacted Without Binder from Partially Volatilized Illinois Coal: Illinois State Geol. Survey Rept. of Investigations 41, 1936, 30 pp.
Singh, A. D., Trends in the Development of Smokeless Fuels: Coal Heat, vol. 49, No. 3, March 1946, pp. 61, 64.

TABLE 11.—World production of fuel briquets, 1939–46, by countries, in metric tons [1]

[Compiled by B. B. Mitchell]

Country [1]	1939	1940	1941	1942	1943	1944	1945	1946
Algeria	103,470	95,250	49,459	45,565	50,685	85,000	101,756	98,320
Australia: Victoria [2]	421,254	(3)	440,718	420,086	421,619	435,727	462,380	512,349
Belgium	1,561,210	1,753,600	1,542,620	1,127.430	1,013,410	456,990	787,530	(3)
Bulgaria	88,496	100,000	(3)	(3)	(3)	(3)	(3)	(3)
Canada	66,242	102,173	172,087	220,139	244,892	277,707	275,625	298,960
Czechoslovakia:								
Coal	508,000	535,000	360,000	468,000	553,000	464,000	(3)	(3)
Lignite	333,000	330,000	295,000	261,000	323,000	328,000	(3)	(3)
Eire	(3)	5,423	15,446	21,052	90,188	123,749	118,558	(3)
France	8,364,000	6,752,330	4,443,920	3,424,550	3,045,910	1,588,490	3,531,530	5,399,403
Germany:								
Coal [4]	[2]6,950,000	[2]6,498,000	[2]7,855,000	[2]7,244,000	[2]7,185,000	[2]6,418,000	(3)	(3)
Lignite [5]	[2]44,930,000	[2]48,853,000	[2]54,409,000	[2]55,293,000	[2]59,706,000	[2]61,549,000	(3)	(3)
Hungary:								
Coal	509,300	512,400	398,140	268,210	227,480	(3)	(3)	(3)
Lignite	51,600	55,020	62,550	57,130	58,250	[6]20,450	[7]13,450	33,670
Indochina, French	185,400	140,100	96,100	54,600	29,800	17,600	(3)	(3)
Italy	83,052	129,404	121,451	(3)	(3)	(3)	(3)	(3)
Netherlands:								
Coal	1,268,926	1,216,930	1,134,555	968,052	896,192	608,316	412,571	725,859
Lignite	68,607	67,734	65,115	57,005	55,457	42,959	35,757	43,655
Netherlands Indies	85,079	99,315	(3)	(3)	(3)	(3)	(3)	(3)
New Zealand	29,889	28,529	20,220	13,052	12,386	12,661	9,941	13,183
Poland	465,390	755,738	756,537	752,960	813,098	765,217	93,078	529,084
Portugal	(3)	(3)	(3)	(3)	(3)	(3)	72,177	(3)
Rumania	245,487	239,424	178,024	194,726	175,877	(3)	(3)	(3)
Spain	789,815	820,479	412,453	788,612	653,994	924,862	1,049,520	(3)
Tunisia	83,989	48,678	24,259	20,691	16,880	1,430	16,619	32,347
Turkey	14,792	24,497	28,392	(3)	30,256	34,276	23,692	(3)
United Kingdom	813,810	(3)	(3)	(3)	749,342	883,974	1,002,333	1,567,664
United States:								
Briquets	809,398	953,328	1,178,069	1,586,023	1,963,136	2,236,163	2,505,816	2,725,193
Packaged fuel	195,504	258,105	244,797	229,560	195,592	159,455	188,823	173,198
Yugoslavia	132,466	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Total [8]	69,158,000	70,374,000	74,304,000	73,515,000	78,511,000	77,434,000	(3)	(3)

[1] 1938 data as published in Minerals Yearbook, 1945, p. 1030, extended or revised as follows: Algeria, 89,640 tons; Canada, 67,348; Czechoslovakia, coal—439,000, lignite—199,000; France, 7,815,530; Hungary, coal—454,790, lignite—45,280; Poland, 653,000; total, 67,014,000.
[2] Data for year ended March 31 of year stated.
[3] Data not available.
[4] Beginning October 1939, figures include production from East Upper Silesia.
[5] Figures include production from Sudetenland.
[6] January to June, inclusive.
[7] June to December, inclusive.
[8] Totals incomplete; represent rounded sum of figures given in table only.

PACKAGED FUEL

The rapid growth of the packaged-fuel industry from 1935 [11] through 1940 and its arrested development during the war years are illustrated in figure 3. The ending of remaining wartime controls by SFAW, OPA, and OTC is discussed in the General Summary at the beginning of this report.

"Packaged fuel" is the trade name applied by the industry to a combination of briquetting and packaging of screenings compressed into 3- or 4-inch cubes and wrapped (six or eight in a package) in sturdy paper and sealed with gummed tape. A study of the development of the packaged-fuel industry, from its beginning with the introduction of coal blocks made from slack in 1928 to the peak of packaged-fuel production in 1940, was made by V. F. Parry [12] of the

[11] First canvass of the packaged-fuel industry by the Bureau of Mines.
[12] Parry, V. F., Technical and Economic Study of Packaged Fuel: Bureau of Mines Rept. of Investigations 3757, 1944, 45 pp.

Bureau of Mines; this study includes operations involved in the manufacture of packaged fuel and analysis of costs in typical plants.

Experiments made by the Bureau of Mines on the use of anthracite in the manufacture of packaged fuel are discussed in the Fuel Briquets section of this chapter under Technologic Developments.

The anticipated success of packaged fuel in the Philadelphia area was of short duration. This fuel (made in Philadelphia by the White Glove Packaged Fuel Division, Blaw-Knox Co., of surplus Pennsylvania anthracite fines blended with a smaller quantity of bituminous coal and an asphalt binder) was introduced to the public in Philadelphia in Gimbel's Department Store in March 1945—when other domestic supplies were short. Thousands of householders placed orders for earliest possible delivery. However, when former domestic anthracite supplies became more plentiful in Philadelphia—the second largest anthracite-consuming city in the United States—the demand for packaged fuel dwindled, and the White Glove plant closed in October 1946. Details of the effort to place packaged fuel on the domestic market in Philadelphia were described [13] in various trade journals and Government publications.

TABLE 12.—Salient statistics of the packaged-fuel industry in the United States, 1942–46

Year	Production (net tons)			Value of production	Plants in operation	Average value per net ton, f. o. b. plant	
	Eastern and Pacific Coast States	Central States	Total			Eastern and Pacific Coast States	Central States
1942	7,583	245,465	253,048	$2,540,087	89	$10.74	$10.02
1943	[1] 4,970	210,635	215,605	2,366,733	72	[1] 11.55	10.96
1944	[1] 3,788	171,982	175,770	2,053,343	68	[1] 12.26	11.67
1945	[1] 16,606	191,537	208,143	2,518,636	61	[1] 12.86	12.04
1946	[1] 9,065	181,854	190,919	2,496,388	70	[1] 12.93	13.08

[1] Eastern States; no production in Pacific Coast States in 1943–46.

PRODUCTION

Continuing shortages of raw fuels, paper, and binder and inability to operate profitably under existing price ceilings [14] were reported as the principal causes of reduced production and idleness in 1946 by packaged-fuel operators.

[13] Solid Fuels Administration for War, P. N. 71018, SFA 254, Sept. 5, 1944.
Barkley, J. F., and Seymour, William, War Problem of Increasing Utilization of Small Anthracite: Mech. Eng., vol. 67, No. 7, July 1945, pp. 457–462.
Fieldner, A. C., and Brewer, R. E., Annual Report of Research and Technologic Work on Coal, Fiscal Year 1945: Bureau of Mines Inf. Circ. 7352, 1946, pp. 68–71.
Coal Age, To Make 150,000 Tons Packaged Fuel a Year: Vol. 49, No. 11, November 1944, p. 117.
American Coal Journal, Large Packaged Fuel Plant Planned for Philadelphia: Vol. 38, No. 3, December 1944, p. 22.
Saward's Journal, New Packaged Fuel Demonstrated: Vol. 27, No. 48, Mar. 3, 1945, p. VI.
Mining Congress Journal, Gimbel's in Philadelphia Will Sell Coal: Vol. 31, No. 5, May 1945, p. 83.
Saward's Journal, New Packaged Fuel Plant Formally Opened in Philadelphia: Vol. 28, No. 8, May 26, 1945, p. 95.
Retail Coalman, "White Glove Fuel": Vol. 81, No. 6, June 1945, pp. 23–24.
Saward's Journal, Packaged Fuel Being Pushed: Vol. 28, No. 47, Feb. 23, 1946, p. VI.
Black Diamond, Trade Notes of New York Territory (introducing "White Glove" Packaged Fuel in New Jersey): Vol. 116, No. 5, Mar. 2, 1946, p. 34.
Saward's Journal, WAA Offers Packaged Fuel Plant: Vol. 29, No. 18, Aug. 3, 1946, p. 252. "White Glove Fuel" Plant Abandoned: Vol. 29, No. 32, Nov. 9, 1946, p. 452. Packaged Fuel Plant Sold: Vol. 29, No. 50, Mar. 15, 1947, p. 712.

[14] Sales of packaged fuel were exempted from price control by the Office of Price Administration, effective Sept. 25, 1946 (SO 166 Amdt. 2 Sept. 25, 1946).

The 70 plants active in 1946 produced 190,919 net tons of packaged fuel, with a value of $2,496,388. The national production decreased 8 percent from 1945, but the decrease in value was less than 1 percent. Production in the Central States was 5 percent less than in 1945, but its value was 3 percent more than in the previous year. The relatively large decrease in production in the Eastern States was due

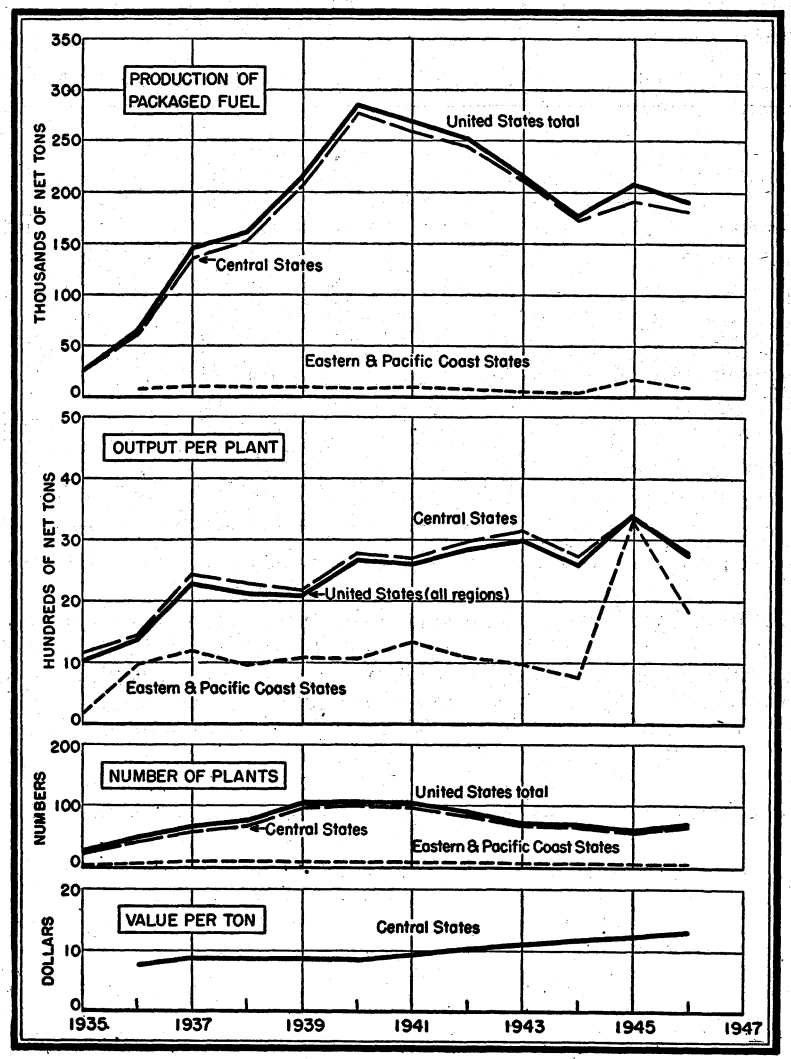

FIGURE 3.—Production of packaged fuel, output per plant, and number of plants in operation in the United States (by regions), and average value per net ton, f. o. b. plant (Central States), 1935–46. (No production in Pacific Coast States, 1943–46.)

principally to the closing down in October 1946 of the plant of the White Glove Packaged Fuel Division, Blaw-Knox Co., Philadelphia. There has been no production of packaged fuel in the Pacific Coast States since 1942.

Output declined in 7 of the 13 producing States and remained stationary or rose slightly in 5 States. Kentucky entered the packaged-fuel field with a new plant at Covington, starting production late in 1946. Michigan and Wisconsin again led in production, and the largest individual producers were the Cleveland-Cliffs Iron Co., Green Bay, Wis., and the Johnson Coal Cubing Co., Inc., Detroit, Mich. One plant reported a fire in 1946, resulting in idleness for 7 months.

TABLE 13.—Production of packaged fuel in the United States, 1945–46, by States

States	1945			1946		
	Plants	Net tons	Value	Plants	Net tons	Value
Eastern States	[1] 5	16,606	$213,476	[1] 5	9,065	$117,206
Central States:						
Illinois	2	(2)	(2)	3	1,454	23,814
Indiana	2	(2)	(2)	2	(2)	(2)
Iowa	1	(2)	(2)	1	(2)	(2)
Kentucky				1	(2)	(2)
Michigan	21	60,034	724,003	27	55,883	741,486
Minnesota	4	35,191	466,045	4	29,319	413,443
Missouri				1	(2)	(2)
Nebraska	1	(2)	(2)	1	(2)	(2)
Ohio	15	32,271	376,839	16	29,239	377,736
Wisconsin	10	47,351	551,680	9	48,087	600,715
Undistributed [2]		16,690	186,593		17,872	221,988
Total Central States	56	191,537	2,305,160	65	181,854	2,379,182
Total United States	61	208,143	2,518,636	70	190,919	2,496,388

[1] Maine, 1; Pennsylvania, 1; and Virginia, 3.
[2] Data which the Bureau of Mines is not at liberty to publish separately are included under "Undistributed."

Value of Production.—The values shown in table 14 represent the average per ton received by operators in 1945 and 1946 in States with three or more operators. The value at the plant comprises cost of coal at the mine, freight rate, direct and indirect manufacturing costs, and profit. Only 1 of the 13 producing States showed a decrease in average realization at the plant in 1946.

TABLE 14.—Average value received per net ton of packaged fuel in the United States, 1945–46, by States

[Includes only States with 3 or more plants in both years]

State	1945	1946	State	1945	1946
Michigan	$12.06	$13.27	Virginia	$10.66	$11.44
Minnesota	13.24	14.10	Wisconsin	11.65	12.49
Ohio	11.68	12.92			

Number of Plants.—The number of plants producing packaged fuel rose from 61 in 1945 to 70 in 1946; 27 of these were in the Detroit and Cleveland areas and contributed about one-third of the total production. Five plants began operations in 1946—2 in Detroit, Mich., and 1 each in Covington, Ky., Kansas City, Mo., and Columbus, Ohio. The number of idle plants dropped from 29 in 1945 to 18 in 1946. Eight plants went out of business in 1946.

Capacity.—The average annual capacity and average annual production per plant in the packaged-fuel industry in the United States, by regions, in 1946, are as follows:

	Average capacity (net tons)	*Average production (net tons)*
Eastern States (5 plants)	18, 560	1, 813
Central States (65 plants)	6, 738	2, 798
Total United States (70 plants)	7, 582	2, 727

Annual capacities of 25,000 tons or more were reported by one eastern plant and three Central States plants. The largest annual capacities in 1946 were reported for the plants of Johnson Coal Cubing Co., Inc., Detroit, Mich., and White Glove Packaged Fuel Division, Blaw-Knox Co., Philadelphia, Pa. (which closed in October 1946).

TABLE 15.—Annual capacity and production of active packaged-fuel plants in the United States, 1937–46

	Active plants		Production		
	Number	Annual capacity (net tons)	Net tons	Percent of— Annual capacity	Percent of— Annual production
1937	64	456, 000	146, 037	32. 0	100. 0
1938	76	500, 000	160, 952	32. 2	100. 0
1939	103	700, 000	215, 507	30. 8	100. 0
1940	106	777, 000	284, 513	36. 6	100. 0
1941	103	698, 000	269, 844	38. 7	100. 0
1942	89	630, 000	253, 048	40. 2	100. 0
1943	72	460, 000	215, 605	46. 9	100. 0
1944	68	428, 600	175, 770	41. 0	100. 0
1945	61	452, 320	208, 143	46. 0	100. 0
1946:					
Capacity of—					
Less than 5,000 tons	[1] 42	109, 860	36, 026	32. 8	18. 9
5,000 to less than 10,000	17	95, 400	31, 094	32. 6	16. 3
10,000 to less than 15,000	4	48, 000	26, 131	54. 4	13. 7
15,000 to less than 25,000	3	60, 000	50, 088	83. 5	26. 2
25,000 to less than 40,000	2	217, 500	47, 580	21. 9	24. 9
40,000 to less than 60,000					
60,000 tons or more	2				
	70	530, 760	190, 919	36. 0	100. 0
Production of—					
Less than 500 tons	[1] 17	39, 240	3, 755	9. 6	2. 0
500 to less than 1,000	15	54, 900	11, 526	21. 0	6. 0
1,000 to less than 3,000	23	87, 120	37, 487	43. 0	19. 6
3,000 to less than 5,000	5	34, 000	17, 788	52. 3	9. 3
5,000 to less than 10,000	6	166, 000	45, 717	27. 5	24. 0
10,000 to less than 25,000	3	149, 500	74, 646	49. 9	39. 1
25,000 tons or more	1				
	70	530, 760	190, 919	36. 0	100. 0

[1] One of these plants began operation in October 1946.

Processes.—No new processes were reported in use for 1946. Sixty-five of the 70 active operations in 1946 used the Eberling process; [15]

[15] Eberling, C. M., Packaged Fuel Produced by the Eberling Process (Cleveland, Ohio): Coal Heat, vol. 28, No. 1, July 1935, pp. 64–66.
Coal Heat, Time to Consider the Future: Vol. 48, No. 3, September 1945, p. 55.

3 used Glenn-Smith equipment;[16] and 2 used equipment designed by Johnson Coal Cubing Co., Inc.,[17] Detroit, Mich. No Leemon equipment was reported in use in 1946. (These processes are briefly discussed by V. F. Parry in his Report of Investigations 3757, previously cited.) Additional machinery was installed at 8 plants in 1946; the 5 new plants reported Eberling installations.

Raw Fuels.—Six kinds of raw fuels (table 16) entered into the manufacture of 8 types of packaged fuel in 1946 (table 17). Bituminous low-volatile coal at 67 plants (in the Eastern and Central States), used either alone or in combination with other fuels, accounted for 91 percent of the total raw fuels used in 1946. Petroleum coke (in

TABLE 16.—Raw fuels used in making packaged fuel in the United States in 1946

Character of raw fuels used	Plants	Net tons	Plants using—	Plants	Raw fuels used (net tons)		
					Yard screenings	Other raw fuels	Total
Bituminous low-volatile	67	171,116	Yard screenings exclusively (from own or other yards)	33	44,348	-------	44,348
Bituminous medium-volatile	1	2,009	Raw fuels (other than yard screenings) exclusively	15	-------	90,151	90,151
Bituminous high-volatile	2		Both yard screenings and other raw fuels	22	18,582	34,585	53,167
Pennsylvania anthracite	1	7,845					
Semianthracite	3						
Petroleum coke	8	6,696					
	[1] 70	187,666		70	62,930	124,736	187,666

[1] 58 plants used 1 kind of fuel only, 8 used 2 kinds (separately), and 4 used mixtures of 2 kinds; hence the sum of the items shown exceeds the total number of active plants.

TABLE 17.—Classification of plants and production of packaged fuel in the United States, by kinds of raw fuel used, 1945–46

Raw fuel used	1945			1946		
	Plants	Packaged fuel produced		Plants	Packaged fuel produced	
		Net tons	Percent of total		Net tons	Percent of total
Bituminous low-volatile (exclusively)	57	167,309	80.4	63	165,734	86.8
Bituminous high-volatile (exclusively)	3	3,147	1.5	1	4,554	2.4
Mixture of bituminous low- and medium-volatile	-------			1		
Mixture of bituminous low- and high-volatile	-------			1		
Mixture of bituminous low-volatile and Pennsylvania anthracite	1	23,154	11.1	1	16,055	8.4
Mixture of bituminous low-volatile and petroleum coke	1			1		
Semianthracite (exclusively)	2			3		
Petroleum coke (exclusively)	7	14,533	7.0	7	4,576	2.4
	[1] 61	208,143	100.0	[1] 70	190,919	100.0

[1] In 1945, 3 types were made at 1 plant and 2 types at 8 plants; in 1946, 2 types were made at 8 plants; hence the sum of the items shown exceeds the total number of plants active in the respective years.

[16] Black Diamond, Briquetting Plant Solves Slack Problem: Vol. 98, No. 6, Mar. 13, 1937, p. 60. (Manufacturing and sales rights of briquetting machinery designed by Glenn Smith acquired in 1944 by Blaw-Knox Co., Pittsburgh, Pa.)
White Glove Packaged Fuel Division of Blaw-Knox Co. (Pittsburgh, Pa.), The Story of White Glove Packaged Fuel: Bull. 2085, 4 pp.

[17] Black Diamond, A Mammoth Package Fuel Plant: Vol. 102, No. 7, Apr. 8, 1939, p. 23. Black Diamond, Packaging Coal at the Johnson Plant at Detroit: Vol. 115, No. 2, July 21, 1945, p. 20.

Illinois, Minnesota, Ohio, and Wisconsin), Pennsylvania anthracite (in Pennsylvania), semianthracite (in Iowa, Missouri, and Nebraska), medium-volatile bituminous (in Ohio), and high-volatile bituminous (in Michigan) were the other raw fuels used.

Binders.—Percent of binder in packaged fuel, by weight, ranged from 0.5 to 5.0 percent. Starch, totaling 1,007 tons and averaging about 15 pounds per ton of packaged fuel produced, is the principal type of binder used and was employed exclusively by 65 plants, producing 138,697 tons, or 73 percent of the total output. Asphalt, totaling 2,211 tons and averaging 89 pounds per ton of packaged fuel produced, was employed exclusively by 3 plants (2 using bituminous low-volatile and 1, a combination of Pennsylvania anthracite and bituminous low-volatile). A combination of asphalt and starch in the manufacture of petroleum-coke cubes was used at 1 plant, and cement was used at 2 plants.

The Eberling and Johnson processes generally employ a starch binder. The Glenn Smith process uses an asphalt binder, making cubes which are also sold in bulk (unwrapped).

TABLE 18.—Classification of packaged-fuel plants in the United States, 1945–46, by type and percentage of binder used

Type of binder	Plants		Percent of binder in packaged fuel (by weight)	Plants	
	1945	1946		1945	1946
Starch	58	65	Less than 0.5 percent		
Starch and asphalt	1	1	0.5 to less than 1 percent	52	58
Asphalt	3	3	1 to less than 2 percent	6	8
Cement		2	2 to less than 3 percent		2
			3 to less than 5 percent	1	2
			5 percent or more	2	1
	[1] 61	[1] 70		61	[2] 70

[1] In 1945 and 1946, 1 plant making 2 types of packaged fuel used starch binder for 1 and starch and asphalt for the other; hence the sum of the items shown exceeds the number of active plants.

[2] In 1946, 1 plant making 2 types of packaged fuel used less than 1 percent binder for 1 and between 1 and 2 percent for the other; hence the sum of the items shown exceeds the number of active plants.

Gem Stones

By SYDNEY H. BALL

JEWELRY INDUSTRY IN 1946

JEWELRY sales in 1946 totaled some $1,709,000,000, an appreciable gain over the previous record year of 1945. For the first 6 months, sales by retail jewelers showed greater gains over those of the previous year than did those of other retailers. During the period many purchases of consequence were made, and the question of price was immaterial; thereafter sales dwindled, and in the last quarter the slight gain over the corresponding period of 1945 was due, not to volume, but to higher prices. The Christmas trade was slightly less than that of 1945, and high-priced goods—including fine diamonds—moved slowly. Customers were more discriminating and more interested in the quality of the goods offered. By the year end prices of mediocre diamonds were appreciably off. The more fashionable stores fared less well than the average. Sales by wholesalers showed greater gains than did those of the retailers, and in consequence retail jewelers' stocks increased during the year.

The 1946 prosperity of the industry was built on a high national income, full employment, an all-time high in marriages, and some drawing upon wartime savings.

On April 29, 1946, platinum was released for civilian use, and thereafter the industry had all the raw materials it needed. In the fall the last price controls were removed from jewelry merchandise.

In 1947 the jeweler will have more competition for the consumer dollar from durable goods, and his customers will seek better values than in 1946. Sales could dip appreciably, however, and the industry remain prosperous.

FASHIONS IN JEWELS

With the war behind us, formal functions are increasing in number; in consequence, there is a more lavish display of jewels, and many a fine gem has emerged from safety-deposit boxes. For evening wear, the white motif is dominant—platinum and diamonds or pearls. The latter have staged a slight come-back. Palladium is still being used, particularly in imposing earrings and clips, where its lightness is an advantage. Gold, often of several tones, is still widely worn, particularly with black gowns. Jewelry continues to gain in colorfulness; diamond pieces often are set with rubies, sapphires, or even less valuable colored gems. More women are acquiring jewelry especially designed to their taste.

Styles in the past year have changed little; but there is a tendency to abandon massive designs, and many of today's designs are lacy

and delicate, with fragile look. Motifs were myriad; flowers were dominant, but leaves, bowknots, snowflakes, sunbursts, and pinwheels were also popular.

Clips, pins and brooches, bracelets, earrings, necklaces, and rings held their popularity, while the use of jeweled hair ornaments grew. Bracelets and necklaces frequently were woven of flexible wire. Necklaces tended to be longer. Many had pendant jewels and others, attached clips. The vogue of pendants from earrings increased; other earrings were clips attached to the top and bottom of the ears.

Some women wore a number of matching clips of graduated size; others, two or more bracelets and even several necklaces. Ensembles of like gems and mountings, say, matching clips, earrings and bracelets are highly prized. Jewelry which can serve a double purpose—an imposing pin separable into two clips or a necklace which can be divided into bracelets—is serviceable and is gaining in popularity.

Although the double-wedding-ring ceremony has become normal, an attempt to induce men to wear more jewelry has been only slightly successful.

The demand for old jewelry, much of it Victorian, is tapering off.

Small cabochon rubies and sapphires replace melee diamonds in some jewelry. The diamond was, by far, the most popular stone, followed by the ruby, sapphire, pearls (both natural and cultured), the emerald, aquamarine and turquoise. Fine aquamarine, while rare and expensive, holds its popularity; turquoise is gaining, but citrine and topaz are losing ground.

The ever-insistent demand for diamonds caused colorless gems to be most popular, followed by blue and red gems; green, yellow, and purple gem stones were in less demand, in the order named.

DOMESTIC PRODUCTION

Plenty of gasoline and greater leisure have permitted the mineral hobbyist to collect more minerals, some of which warrant cutting. The lapidary industry, professional and amateur, in the Western States continues to expand markedly; and now that its best customer, the auto tourist, is again on the road, the demand for cut-gem stones has increased. The American costume-jewelry industry, shut off during the war from European sources of supply, is a second outlet for the product. In consequence, production of gem stones may have skyrocketed from an estimated value (at the source) of $40,000 in 1945 to some $325,000 in 1946, but these figures are at best, rough estimates.

Prices during the year increased considerably, warranting the producer in risking capital today that he would not have dared to do in prewar days.

Jade, followed by agate, turquoise, and then variscite, were the most important gem stones produced. Of the States and Territories, Wyoming led, followed by Oregon, Alaska, Washington, and Nevada.

The jade (nephrite) industry of the Kobuk River region, Alaska, is likely to employ a few miners and may employ some of the local Eskimos cutting for the tourist trade. Nephrite occurs as float and pebbles, also in place in the Jade and Cosmos Hills. Most of the

material is poor, but part is suitable for objets d'art and for tourist jewelry. The Arctic Circle Exploration Co. is the principal producer and fabricator. B. D. Stewart, Alaska Commissioner of Mines, informs the author that, in the summer of 1946, the company shipped 13¾ tons of jade and that a Fairbanks trader exported 100 pounds, some of which was of excellent quality. Some of the material in the rough is worth $5 a pound, and selected material is said to have brought $55 a pound.

Wyoming increased its production of nephrite from the Lander region, and at least one new occurrence of jade in place is reported. Many miners from outside the State visited the area in 1946. There are three lapidaries at Lander; in addition, some jade is exported to China, where it is cut. Some of the rough was sold for as much as $15 a pound. Most of the material is of more or less the quality of New Zealand jade, although some is said to be equal to that of Chinese Turkestan. Much of the jade land was located under the Placer Act, but apparently only in a few instances has enough work been done to hold them legally. Whether one buys or sells jade boulders, he gambles, for in no case is the value of the material known until it is cut.

After jade, agate and related quartz minerals, were the most important gem stones produced and are the principal materials cut by the large number of professional and amateur lapidaries in the West. Although some deposits have been worked out, the numerous agate prospectors have found deposits more than compensating for the exhaustion of the old deposits. Where virtually all of the float has been collected, underground work has started in several districts, a condition permitted by the higher price paid for the raw material. Dr. H. C. Dake, Portland, Oreg., believes that central Oregon is the chief producer. From a single pocket near Post, $8,000 worth of agate was recovered in 3 days, including a single mass weighing 186 pounds, which was sold for $1,000. Plume agates and other types of chalcedony are the principal products. Washington was perhaps the next most important producer.

The moss agate deposits of the flats of the Yellowstone River, Mont., are partly exhausted, but they still supply material to six professional lapidary shops and to scores of amateur lapidaries. A. Harrington reports that Idaho's production of moss agate increased in 1946 but that there were no new discoveries of importance. Owyhee County is one of the larger producers. The nodules called "thunder eggs" are in demand.

Gordon Bowser of San Luis Obispo, Calif., produced about a ton of moss agate worth $6,000. A little agate was also produced in San Bernardino County. Considerable plume agate was produced in south central Colorado, according to Richard M. Pearl, and from the Embargo mining district, Colo. T. D. Benjowsky reports that red jasper was mined near Hot Springs, Sierra County, N. Mex., and other agate species in Socorro and Catron Counties. A new source of dendritic chalcedony was discovered during the year near Fort Cummings, Luna County, N. Mex. When cut, it finds a ready market in the Southwest and in southern California.

Charles E. Hill reports finding a new agate locality in Yavapai County, Ariz., from which he mined some fine stones.

Agate nodules, weathering from lavas in Trans-Pecos, Tex., were collected in quantity in 1946 and sent to various lapidaries. Arizona produced some agate.

Alfred M. Buranek reports that the number of lapidary shops in Utah has grown remarkably during the year and that several new deposits of agate have been discovered. Agate was produced in the Dugway area, and moss agate and jasper from the Topaz, Jericho, and Beaver areas. So much material is being shipped to other States that the Mineralogical Society of Utah is preparing a bill to be presented to the legislature to prohibit nonresidents from shipping these minerals in quantity beyond the State boundaries.

In value, turquoise was probably the third most important American gem stone produced in 1946, although statistical data are scanty. Nevada was probably the leading producer. The Nevada Turquoise Co., of Mina, Mineral County, is said to have produced turquoise valued at more than $20,000. The Pedro claim of the Copper Canyon Mining Co. produced perhaps nearly as much. During the last 5 months of 1946, rough turquoise was recovered by the Castle Dome Copper Co., Inc., through the sorting of a small percentage of the ore broken in its routine mining operations, according to R. W. Hughes, general manager. The turquoise so recovered ranged in grade from thin, hard flakes with deep blue color through various degrees of hardness and shades of blue down to colorless chalky material.

The King turquoise mine at Manassa, Conejos County, Colo., leased by Horace and Wallace King, produced 2,000 pounds worth $30,000.

A "composite turquoise" (small fragments of Arizona turquoise in a matrix of black cement) is on the market and is rather attractive. Los Cerrillos, N. Mex., produced a little turquoise, largely by local labor near the mine. It was sold to lapidaries in the vicinity. The United Indian Traders Association has set up standards for hand-made Navajo and Pueblo jewelry and is prepared to license its mark.

Utah continues to produce some variscite. Alfred M. Buranek reports that the Clay Canyon deposits were worked, as was the Lucin (Box Elder County) on a somewhat smaller scale. Junius J. Hayes reports that collectors got some variscite from the Grantsville deposit in Tooele County.

Some geophysical work was done in the vicinity of the Murfreesboro, Ark., diamondiferous pipes. The main company is again in litigation. Some 40 years ago a few small, alluvial diamonds were reported to have been recovered at a gold placer near McCall, Idaho. Late in 1946 that ground was leased and some development work started.

Montana apparently produced no sapphire in 1946.

A considerable amount of "flowering" obsidian was mined in Utah. In Arizona some "marekanite" was produced. This is a semitransparent smoky glass nodule occurring in obsidian.

Kelley and Branson[1] describe small Tertiary pegmatite masses on the west slope of the Black Range, Grant County, N. Mex. The pegmatite consists largely of quartz and sanidine; the latter, which occurs in fair-size masses, "displays blue and white opalescence, giving rise to a moonstone of commercial quality." A little may have been produced in 1946.

[1] Kelley, V. C., and Branson, O. T., Bull. Geol. Soc. America, vol. 57, December 1946, p. 1255.

The Barton Mines Corp., North Creek, Warren County, N. Y., sells some of its garnets to lapidaries. The color is good, but the market is of limited scope. Valley and Adams Counties, Idaho, have garnet deposits, but as far as is known none was worked in 1946. In the extreme southeastern part of Utah pyrope garnets of good color, some over a half inch in diameter, occur in gold placers.

Other gem stones produced in small amounts in 1946 include agatized wood (Arizona and New Mexico); alabaster (South Dakota); amethyst (Dugway area, Utah); aquamarine (Deep Creek, Utah, and San Diego, Calif.); kunzite (San Diego, Calif.); kyanite (Upson County, Ga.); opal (17 miles south of Marsing, Idaho); opalized wood (central Washington); pipestone (Pipestone, Minn.); rock crystal (Crystal Mountain, Ark.); rose quartz (South Dakota); staurolite (Cherokee County, Ga.); topaz (Tarryall Mountains, Colo., and Topaz Mountain, Utah); and tourmaline (San Diego, Calif., and Mount Apatite, Maine).

GOVERNMENT REGULATIONS

A number of Government regulations enacted in 1946 affected the trade in precious stones. The majority of such measures were passed in the hope of increased revenue.

The United States removed control from all jewelry items, but apparently for some time to come is not to reduce the excise tax (20 percent). Maine in 1946 placed a 5-percent luxury tax on jewelry sales in addition to the 20-percent Federal tax. During the year, the United States also removed controls on the price and export of industrial diamonds and diamond-set tools.

Canada removed all controls from diamonds and gem stones on March 15, 1946, and India on July 29, 1946. Import duties on jewelry were increased by Argentina, Czechoslovakia, Mexico, and Paraguay. Luxury taxes on jewelry were established in China (50 percent), Spain (20 percent), and France (25 percent), and Mexico added a 5-percent sales tax on jewelry sold in the Federal district. Italy, permitted the purchase, sale, and transfer of jewelry and precious stones after April 26, 1946, but not their exportation. Egypt, while still prohibiting transit trade in gold and jewelry, now permits the importation of gold, provided it is reexported within 6 months. France no longer requires a license for exporting jewelry and precious stones. On the other hand, such commodities exported from Burma require a license granted by the Reserve Bank of India. As France received fewer industrial diamonds than its needs, the commodity was placed under Government control.

IMPORTS

The value of imports of precious and semiprecious, real and imitation stones, exclusive of industrial diamonds, as listed by the United States Department of Commerce, totaled $189,017,646—65 percent more than in 1945. Diamonds were over 88 percent of the total. Fine gem stones and pearls and cut imitation stones showed large increases.

Precious and semiprecious stones (exclusive of industrial diamonds) imported for consumption in the United States, 1945–46 [1]

Commodity	1945		1946	
	Carats	Value	Carats	Value
Diamonds:				
Rough or uncut (suitable for cutting into gem stones), duty free	893, 761	$43, 122, 622	1, 044, 517	$48, 668, 843
Cut but unset, suitable for jewelry, dutiable	377, 243	64, 185, 406	604, 638	117, 968, 206
Emeralds:				
Rough or uncut, free	1, 085	252	544, 711	579, 745
Cut but not set, dutiable	106, 684	181, 834	11, 902	210, 274
Pearls and parts, not strung or set, dutiable:				
Natural		352, 947		619, 463
Cultured or cultivated		155, 548		1, 280, 867
Other precious and semiprecious stones:				
Rough or uncut, free		134, 698		329, 552
Cut but not set, dutiable		5, 113, 937		8, 932, 862
Imitation, except opaque, dutiable:				
Not cut or faceted		3, 220		68, 108
Cut or faceted:				
Synthetic		805, 838		1, 640, 426
Other		242, 988		8, 044, 674
Imitation, opaque, including imitation pearls, dutiable		31, 136		298, 545
Marcasites, dutiable:				
Real		101, 140		344, 907
Imitation		3, 665		31, 174
		114, 435, 231		189, 017, 646

[1] In the corresponding table in Minerals Yearbook, 1945, p. 1548 and Minerals Yearbook, 1944, p. 1518 data for 1944 should be revised as follows: Diamonds, rough or uncut, $43,549,837; cut but unset, $29,003,536; emeralds, cut but not set, $70,924; pearls and parts, natural, $244,879; total value, $77,367,188.

DIAMOND

For mining companies, wholesalers, and retailers, 1946 was even a better year in the diamond industry than the previous record year, 1945. The cutters, on the other hand, had a far from satisfactory year.

Production was less by weight than in 1945 but greater in value. Output of gem stones in southern Africa and Tanganyika Territory increased, whereas the break-down of war-worn machinery cut deeply into Belgian Congo's production, which is dominantly of industrial grades.

Sales of rough by the principal wholesaler, the Diamond Corp., were £30,000,000, or 22 percent greater than those of the previous record year 1945. Production did not meet sales, and stocks were depleted further; the day when all sales must be made from current production approaches.

With the war over, the market for cut diamonds is broadening, but few countries are as yet able to pay for luxuries, although investment buying continues. The American retailer never sold so many cut diamonds, although demand weakened in the last quarter of the year.

The cutting industry alone was not prosperous. During and since the war the industry mushroomed, and its capacity to cut exceeds the rough now available. In consequence, unemployment, strikes, and lock-outs were common, and there was a tendency toward lower wages.

Prices of rough were raised moderately in gem grades and somewhat more so in industrials, which during the war sold at less than prewar prices. Prices of polished diamonds were slightly increased in the first half of the year but weakened in the last quarter, particularly prices of mediocre-quality stones.

As was to be expected, with the end of the war, fewer industrials were used. In 1946 the users were, however, importing stones of finer quality than those used during the war, hence the dollar value approached that of wartime imports.

Share Dealings.—The shares of the leading diamond mining companies on the London Stock Exchange, their principal market, gained about 17 percent. Quotations early in June 1946 were at practically an all-time high. Thereafter they fluctuated and declined slightly. All of the principal diamond-mining companies except Premier paid dividends in 1946.

Imports.—Imports of gem diamonds into the United States increased from $107,308,028 in 1945 to $166,637,049 in 1946—a gain of 55 percent.

The accompanying table shows comparative figures of imports during 1945 and 1946. The imports of rough in the latter year were greater by 17 percent, as to carats, and 13 percent, as to value. The gain in imports of cut was 60 percent, as to carats, and 84 percent as to value. The grade of the 1946 rough imports was poorer, and the grade of cut about the same.

Diamonds imported for consumption in the United States, 1945–46,[1] by countries

[Exclusive of industrial diamonds]

Country	Rough or uncut			Cut but unset		
	Carats	Value		Carats	Value	
		Total	Average		Total	Average
1945						
Argentina				4	$2,000	$500.00
Austria				12	1,136	94.67
Belgian Congo	10,054	$86,793	$8.63			
Belgium and Luxembourg				104,840	14,612,123	139.38
Brazil	14,349	628,325	43.79	28,472	4,988,200	175.20
British East Africa	7,413	207,556	28.00			
British Guiana	1,774	42,715	24.08	580	67,471	116.33
British West Africa	1,158	21,402	18.48			
Canada	1,110	16,650	15.00	1	100	100.00
Cuba				64,737	11,439,698	176.71
France				44	7,511	170.70
Germany				1,230	133,496	108.53
India and Dependencies				703	134,641	191.52
Mexico	13,838	504,641	36.47	9	5,003	555.89
Netherlands				2,599	520,516	200.28
Palestine and Trans-Jordan				105,899	17,684,997	167.00
Portugal				18	6,405	355.83
Switzerland				271	39,738	146.63
Union of South Africa	834,393	41,290,329	49.49	46,096	10,720,816	232.58
U. S. S. R.				3,569	562,617	157.64
United Kingdom	5,699	173,797	30.50	17,535	3,176,270	181.14
Venezuela	3,973	150,414	37.86	624	82,668	132.48
Total 1945	893,761	43,122,622	48.25	377,243	64,185,406	170.14

See footnote at end of table.

Diamonds imported for consumption in the United States, 1945–46,[1] by countries—Continued

[Exclusive of industrial diamonds]

Country	Rough or uncut			Cut but unset		
	Carats	Value		Carats	Value	
		Total	Average		Total	Average
1946						
Argentina				114	$20,754	$182.05
Belgian Congo	5,649	$48,834	$8.64			
Belgium and Luxembourg	3,104	135,882	43.78	288,929	51,150,251	177.03
Brazil	59,142	2,766,768	46.78	15,939	3,228,079	202.53
British East Africa	12,685	636,129	50.15			
British Guiana	3,246	175,033	53.92	752	84,802	112.77
British Malaya	2,500	20,169	8.07	617	177,379	287.49
Canada				127	8,674	68.30
Cuba	383	4,743	12.38	38,325	7,502,503	195.76
Denmark				4	610	152.50
Egypt				34	10,082	296.53
France				6,042	1,186,641	196.40
Greece				240	16,444	68.52
Hungary				107	4,575	42.76
India and Dependencies				929	183,941	198.00
Iran				200	40,243	201.22
Japan				3	1,215	405.00
Mexico				313	62,566	199.89
Netherlands	124	15,335	123.67	37,473	7,724,355	206.13
Palestine and Trans-Jordan	3,566	115,927	32.51	121,627	21,972,027	180.65
Portugal				671	146,431	218.23
Siam				40	9,411	235.28
Sweden				10	2,183	218.30
Switzerland				7,776	1,470,574	189.12
Union of South Africa	935,824	44,015,089	47.03	56.120	16,783,704	299.07
U. S. S. R.				4,796	1,002,000	208.92
United Kingdom	10,693	351,113	32.84	23,198	5,134,475	221.33
Venezuela	7,601	383,821	50.50	252	44,287	175.74
Total 1946	1,044,517	48,668,843	46.59	604,638	117,968,206	195.11

[1] In the corresponding table in Minerals Yearbook, 1945, p. 1550 and Minerals Yearbook, 1944, p. 1521, data for 1944 should be revised as follows: Rough or uncut: Brazil, total value, $830,996; average value, $32.44. Grand total value, $43,549,837; total average value $48.58. Cut but unset: Brazil, total value, $4,014,301; average value, $160.37; U. S. S. R., total value, $147,604; average value, $102.79. Grand total value, $29,003,536; total average value, $171.52.

Cutting.—At the end of 1945 there were some 25,000 cutters in the world; at the end of 1946, some 35,000. Decreases in Brazil, the United States, Cuba, and Puerto Rico were more than offset by a large increase in Belgium and a smaller one in Palestine. Even in 1945 there was inadequate rough to insure full employment; and in 1946, as the supply was not much greater, there was a chronic shortage of rough, resulting in unemployment for the artisans and inadequate profits for the master cutters. Belgium is by far the largest cutting center, followed by Palestine, New York, and Cuba. Some of the war-born centers will disappear over the next few years, and others will be deflated. The best cutting of sizes is done in the United States and that of melee in Palestine, Belgium, and the United States.

World Production.—Accurate figures regarding diamond production still are not available for many countries, but the estimates in the following table are believed to be fairly reliable. World production (gems and industrials) in 1946 is estimated to have been 10,313,000 carats (2.27 short tons) worth at the mine about $81,400,000 which compares with 14,384,000 carats (3.17 short tons) in 1945. The quantity was 72 percent of that of 1945, but the value at the mine showed an increase of about 25 percent. The increase in value was

due to the increased production of gem grades (both as to carats and value) and the advance in the price of cuttables. By weight, about 1,228 pounds were gem stones and 3,315 pounds industrials.

Belgian Congo was the leading producer by weight (59 percent), although it represented only 11 percent of the value. On the other hand, the British Commonwealth, accounting for only 29 percent of the weight, represented about 70 percent of the value.

Union of South Africa, South-West Africa, Tanganyika Territory and Gold Coast showed gains, and Belgian Congo a loss. At Kimberley, the Dutoitspan and Bulfontein pipe mines continued to operate, and in a year or two Premier and New Jagersfontein will resume production.

The accompanying table shows available statistics and estimates of world production for the past 5 years.

World production of diamonds, 1942–46, by countries, in metric carats

[Including industrial diamonds]

Country	1942	1943	1944	1945	1946
Africa:					
Angola	791,853	794,990	799,120	803,887	[1] 808,000
Belgian Congo	6,018,236	4,881,639	7,533,365	10,386,000	6,033,452
French Equatorial Africa	46,345	56,183	60,000	82,849	87,381
French West Africa	49,866	36,193	69,726	79,802	51,834
Gold Coast [2]	1,055,735	1,317,798	1,165,858	812,451	830,000
Sierra Leone	1,046,187	834,492	608,744	504,309	559,229
South-West Africa	56,420	94,427	154,379	152,629	163,611
Tanganyika	40,327	52,998	90,667	115,666	[1] 119,446
Union of South Africa:					
Mines	858	84,342	552,974	878,713	1,025,019
Alluvial	117,963	217,987	380,708	262,529	256,768
Total Union of South Africa	118,821	302,329	933,682	1,141,242	1,281,787
Brazil [1]	300,000	275,000	301,000	275,000	325,000
British Guiana	22,207	18,272	[2] 13,911	15,442	30,958
Venezuela	34,048	22,846	22,037	12,769	20,912
Other countries	6,788	6,804	12,000	2,000	[3] 1,600
Grand total	9,587,000	8,694,000	11,764,000	14,384,000	10,313,000

[1] Estimated.
[2] Exports.
[3] Partly estimated; includes India, Borneo, Australia (New South Wales), and U. S. S. R.

Industrial Diamonds.—In the first year after World War II ended, the imports of industrial diamonds decreased markedly in carats but in dollar value compared favorably with all previous years except 1942–44. Consumption and production approached balance, but many grades were in short supply. Manufacturers of diamond-set tools must still be careful in using those industrial stones available.

From the spring of 1946 on, the principal wholesaler of industrial stones was Industrial Distributors (1946) Ltd.

On July 23, 1946, the Strategic and Critical Materials Stock Piling Act (Public Law 520, 79th Congress) was approved. All diamonds then in the hands of Government agencies were transferred to the stock pile, and additional industrials are to be purchased.

After World War II broke out, the price of crushing bort was halved and that of other grades remained steady during the war. In 1946

the price of crushing bort was raised 80 percent and that of other grades somewhat less.

The year saw many improvements, but few innovations, in the use of industrial diamonds.

Figure 1, originally prepared by Herbert Backman several years ago, shows the tremendous increase in use and the sharp decline in the price per carat of American imports in the past 28 years.

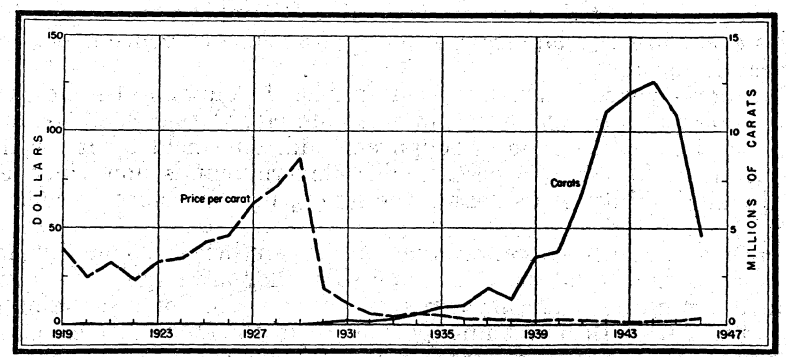

FIGURE 1.—United States imports and average price per carat of industrial diamonds, 1919–46.

Imports of industrial diamonds into the United States during the past 5 years were as follows:

Industrial diamonds (glaziers', engravers', and miners') imported for consumption in the United States, 1942–46

Year	Carats	Value		Year	Carats	Value	
		Total	Average			Total	Average
1942	11, 203, 704	$22, 057, 577	$1. 97	1945	10, 729, 869	$12, 810, 932	$1. 19
1943	12, 084, 133	21, 890, 568	1. 81	1946	4, 625, 282	14, 297, 536	3. 09
1944	12, 614, 507	22, 894, 244	1. 81				

RUBY, SAPPHIRE, AND EMERALD

Because of the dominant position of the diamond in the gem market and the fact that ruby, sapphire, and emerald deposits do not lend themselves to large-scale operations, gem mining by large companies is confined to the diamond. Fine rubies come from Burma; sapphires from Siam, Ceylon, Indochina, and Kashmir (according to rumor, the deposits in the latter two countries are practically exhausted), and emeralds from Colombia and U. S. S. R. Burma, Siam, and Indochina are none too peaceful at the moment, a condition scarcely conducive to large production. The Colombian emerald mines are not being operated, and the Ceylon sapphire production is still subnormal. Shipments from the mines are greater than in the past war years; but fine gems are in short supply, and jewelers' stocks and outmoded jewelry still contribute the major part of our supply.

793065—48——36

Fine gems are by no means modestly priced, and American buyers must compete with Oriental lovers of these gems.

Wadia and Fernando (see Bibliography) have written an interesting article on gem mining in Ceylon, an important producer of sapphire and many of the lesser gems.

Siam would welcome American capital in developing its gem resources, but so far there have been few candidates. Who will eventually own the sapphire deposits on the common boundary of Siam and Indochina is at the moment in doubt. Sapphires and even a few rubies occur in Brazilian gravels, but no known occurrence is of commercial importance.

During the year, the Bank of the Republic of Colombia (the Government hoping to interest tourists in emerald matrix) sold 828.75 carats of cut and 342,552 carats of rough emerald, long held by it for the Government, for 573,076 pesos. The Government is now considering the advisability of reopening the mines, inactive since December 1938.

Transvaal, South Africa, produces a few gem beryls, some of which are dark enough to be classed as emeralds; they are largely, however, of mediocre grade. The principal producer is the Somerset mine of the South Africa Beryl Mining Co. Most of the stones are exported to India. In the first quarter of 1946, 2,902 carats worth £1,433 (about $5,732, or $1.98 per carat) were sent to India.

It is reported that the American synthetics, "Chatham synthetic emeralds," are being improved in size, depth of color, and quality.[2]

LESSER GEMS

In 1946, there was a scarcity of desirable gem stones; due to this, plus higher cutting costs and good demand, prices advanced. In the last quarter of the year, prices softened, and particularly those of mediocre qualities fell.

In February 1946 new and rich opal fields were found at Coober Pedy, Central Australia, 1,200 miles from Adelaide.

Due to the inflation in China, the Chinese are investing in jade, and prices are 5 to 10 times those of prewar days. Shelves of the dealers are practically bare, and little is being exported to the United States. The jade centers of Peking and Canton are languishing, war having cut them off from the jadeite of Burma and the nephrite of Turkestan. As master cutters no longer receive imperial subsidies, the lapidary art is deteriorating.

The popularity of aquamarine continues to grow. The supply of fine Brazilian is inadequate, and prices still are rising. Late in October, an aquamarine weighing 56 pounds was flown from Brazil to New York. The stone was found near Resplendor, Minas Gerais. It is a rough, hexagonal prism, 11 inches high and 10 inches in diameter. The stone, it is claimed, was insured for $500,000, and the owners hope the cut stones from it will be worth $2,500,000. The Indian deposits of beryl have recently been described.[3] The Bisundni Mine, Rajputana, produces a little gem material of pale green color, as well as rose quartz,

[2] Switzer, George, Gems and Gemology, Spring 1946, pp. 305-307.
[3] Bureau of Mines, Mineral Trade Notes: Vol. 22, No. 3, March 1946, pp. 4-9.

and the Vasanta Kalyani mica mine, Madras, some beryl suitable for gem purposes.

The precious stone industry of Brazil is, under government patronage, to create a Precious Stone Exchange. Among the objects are to assist diamond mining, protect cutters, reduce taxes on precious stones, and simplify exporting. Before World War II, Brazil exported most of its precious stones to the Idar district, Germany. During the war, lapidary shops sprang up in Brazil. Attempts are now being made to introduce modern methods in these shops.

Emerson I. Brown, minerals attaché at the United States Embassy in Rio [4] gives an interesting summary of the precious stone industry in Brazil. He states that supply exceeds demand, the American market being dull, although the European market is becoming active. Export prices are off as much as one-third.

Edward R. Swoboda describes the spodumenes of Brazil (see Bibliography). While most of the material is colorless, kunzite and yellow spodumene also occur, and rarely deep green spodumene.

Philip Lichtenberg [5] describes the mica-tourmaline deposit of Cruzeiro, Minas Gerais, which he says is the most important producer of tourmaline in Brazil.

Some fine olivines have appeared on the American market from stocks of the mining company that once operated the well-known deposit on Zebirget Island in the Red Sea.

The Soviet Government, under the current 5-year plan, is to increase notably the production of its lapidary trust, Russkie Samotsvety. Sverdlovsk and a town in the Altai are cutting centers, and the personnel is to be increased. The production of the lesser gems and ornamental stones is to be raised, and objets d'art and stones for jewelry cut.

The French are attempting to revive the gem-mining industry of Madagascar, an important producer of gems for jewelry as well as industrial applications. Mining taxes were reduced as of June 2, 1945. Madagascar produces a large number of gem stones, but the percentage suitable for cutting is small, most of them being used industrially.

E. Ruff [6] describes the large number of gem stones which occur in New Zealand. Jade (nephrite) alone is, however, of commercial importance.

Before World War II, South-West Africa was an important source of gem stones for the German lapidary industry. In 1939, the last year of export to Germany, the total value was but £1,132.

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[4] Bureau of Mines, Mineral Trade Notes: Vol. 23, No. 5, November 1946, pp. 49–52.
[5] Jewelers' Circular-Keystone, December 1946, pp. 236–238, 310–311.
[6] Jour. Gemology, September 1946, pp. 551–553.

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Gold and Silver

By CHARLES WHITE MERRILL AND HELENA M. MEYER

	PAGE
General summary	557
Salient statistics	559
Legislation and regulations	559
International monetary agreements	560
Domestic production	560
Mine production	561
Principal mining districts and leading mines	562
Ore production, classification, metal yield, and methods of recovery	569
Placers	575
Refinery production	575
Consumption and uses in industry and the arts	576
Monetary stocks	578
Prices	578
Foreign trade	579
World review	580
Canada	585
Mexico and Central America	585
South America	586
Africa	586
Asia	587
Oceania	587

GENERAL SUMMARY

UNITED STATES mine production of gold in 1946 increased 65 percent compared with 1945; but, except for the war years, 1943–45 output was the smallest since 1885. Silver output declined 21 percent in 1946 and, except for 1932, was at the lowest point since 1872. The gold-mining industry had returned to unrestricted operations when War Production Board Order L–208 was rescinded, effective July 1, 1945; but many mines, productive in the prewar years, did not resume work or did so on a restricted scale only. Higher prices for equipment and supplies and higher wages, combined with the difficulties of recruiting efficient labor forces, made former operators reluctant to reopen mines with narrow profit margins before the war. Moreover, in many instances the years of idleness had resulted in deterioration in plants and mine workings which called for very large capital outlays for rehabilitation. Gold production also was reduced in 1946 by prolonged strikes at base-metal mines; byproduct gold from such mines had been an important factor in sustaining output during the war years. In 1945 slightly over half of the gold output was recovered from base-metal ores, but in 1946 base-metal ores accounted for 23 percent, placers 38 percent, and dry ores 39 percent.

The continued decline in silver output resulted largely from the long strike-enforced idleness at base-metal mines where most of the country's silver is derived as a byproduct. Labor strikes at copper and lead smelters, where much silver is recovered, were likewise adverse factors in silver production.

California regained first place as a gold producer from Utah, which sank to fourth place. Second and third places in 1946 were occupied

by South Dakota and Alaska, respectively; these and California supplied 57 percent of the United States output. The three leaders depended very largely on straight gold mines, both lodes and placers. The four leading silver States—Idaho, Utah, Montana, and Arizona—produced 75 percent of the domestic mine silver.

The recovery of gold was divided fairly evenly among placer methods, amalgamation-cyanidation mills, and smelting of crude ores and concentrates, only a very small part of which was recovered by the direct smelting of ore. Almost 82 percent of the domestic silver output was recovered by the smelting of concentrates and nearly all of the remainder by the direct smelting of ore.

Gold production outside the United States increased slightly in 1946 compared with 1945 largely because of estimates of Russian output reflecting a belief in postwar recovery there. Silver output outside of the United States declined proportionately less than in the United States. Labor difficulties, particularly in the Union of South Africa, hampered full operation. In that country, however, deep drilling at Odendaalsrust, 150 miles southwest of Johannesburg, cut very rich ore early in 1946. Predictions of greatly extended life for a large gold-mining industry were freely made, and a boom of major proportions in gold-mining shares developed.

Owing to restrictions on the international movement of gold and silver and the measures taken by governments to stabilize the exchange value of currencies, gold and silver lost much of their monetary significance. The eagerness of individuals to acquire the metals, however, appears to have increased, particularly where the monetary regulations were the most arbitrary. The press reported very high prices for both metals in a number of foreign markets. These prices were sustained, however, by various government regulations that restricted the movement of metals to markets and the conversion of proceeds of sales to the national currency of the seller. Moreover, some of the reported trading was conducted in black markets. Reports of high prices for gold led some domestic producers to advocate regulations under the Gold Reserve Act that would permit the free export of gold. Free export, however, would not insure profitable access to foreign markets because foreign gold import laws in most, if not all instances, provided that the gold be received by the foreign treasury or state bank; the price to be paid for it when exchanged was not to exceed $35 a fine ounce.

The Treasury buying price for gold continued at $35 per fine ounce throughout 1946; but the buying price for silver which had stood at $0.7111+ since July 1, 1939, was raised for metal produced domestically after July 1, 1946, to $0.905 where it remained for the remainder of the year. The price for silver that could not qualify for Treasury purchase was held at $0.7111+ by Office of Price Administration ceiling until July 1 and was placed under a ceiling of $0.905 shortly after OPA was reestablished late in July. By the end of the year, however, the New York "official" price for 0.999 fine silver had declined to $0.8375.

The outflows of gold since 1944 and of silver since 1943 were reversed in 1946, when the movements in these metals resulted in substantial gains in United States supplies.

Salient statistics of gold and silver in the United States,[1] 1942-46

	1942	1943	1944	1945	1946
Mine production, fine ounces:					
Gold	3,457,110	1,363,815	998,394	954,572	1,574,505
Silver	54,090,765	41,460,826	34,473,540	29,024,197	22,914,604
Ore (dry and siliceous) produced (short tons):					
Gold ore	9,487,907	3,766,149	1,964,680	1,364,308	2,395,500
Gold-silver ore	1,163,970	553,566	364,698	276,530	389,681
Silver ore	996,823	643,271	290,297	343,458	209,626
Percentage derived from—					
Dry and siliceous ores:					
Gold	50	38	30	30	40
Silver	37	26	17	24	24
Base metal ores:					
Gold	21	50	58	51	23
Silver	63	74	83	76	75
Placers:					
Gold	29	12	12	19	37
Silver	(2)	(2)	(2)	(2)	(2)
Net industrial consumption:					
Gold	$47,294,810	$86,343,353	$97,298,283	$108,944,332	$153,687,000
Silver, fine ounces	101,398,695	118,000,000	120,100,000	126,300,000	87,000,000
Imports:					
Gold	$315,779,716	$101,792,745	$113,836,359	$93,718,050	$532,961,768
Silver	$41,103,149	$27,902,960	$23,373,037	$27,278,396	$57,577,888
Exports:					
Gold	$102,126	$32,854,590	$959,227,923	$199,967,940	$221,467,636
Silver	$1,999,490	$30,689,397	$126,915,344	$90,936,901	$36,454,690
Monetary stocks:[3]					
Gold	$22,726,000,000	$21,938,000,000	$20,619,000,000	$20,065,000,000	$20,529,000,000
Silver, fine ounces	2,838,000,000	2,687,000,000	2,345,000,000	2,005,000,000	1,951,000,000
Price, average, per fine ounce:					
Gold	$35.00	$35.00	$35.00	$35.00	$35.00
Silver	$0.711+	$0.711+	$0.711+	$0.711+	$0.808
World production, fine ounces:[4]					
Gold	36,300,000	29,200,000	26,700,000	26,300,000	27,800,000
Silver	250,000,000	217,100,000	186,200,000	157,300,000	129,000,000

[1] Philippine Islands and Puerto Rico excluded.
[2] Less than 0.5 percent.
[3] Owned by Treasury Department; privately held coinage not included.
[4] Estimated.

LEGISLATION AND REGULATIONS

Silver was the subject of some new legislation and Government regulation during 1946, but gold was substantially unaffected. The Green Act, which permitted the sale of Treasury silver at 71.11+ cents an ounce for use in the arts and industries, expired December 31, 1945, and was not extended. The Office of Price Administration maintained the price ceiling at 71.11+ cents—the Treasury buying price for domestically mined silver. On July 1 the OPA expired, but a free market for silver was slow to develop. By July 26, when OPA was reestablished, the price of silver had reached 90⅝ cents. On July 31 the President approved an act amending the Silver Purchase Act of 1939 that raised the price paid by the Treasury for silver domestically mined after July 1, 1946, from 71.11+ to 90.5 cents an ounce. This act also provided for sales of Treasury silver for use in the arts and industries at prices not lower than 90.5 cents. The OPA raised its ceiling on silver price to permit sales at the higher price. Silver was freed from OPA price control by a Price Administrator order November 10, 1946.

INTERNATIONAL MONETARY AGREEMENTS

The agreements formulated by the representatives of 44 nations at Bretton Woods, N. H., in July 1944 had been ratified by enough governments during 1945 so that two of the most important institutions created—the International Monetary Fund and the International Bank for Reconstruction and Development—came into existence on December 27, 1945. During 1946 staffs were recruited and capital collected for these organizations. On December 18, 1946, the Fund took an important step toward world currency stability by announcing initial par values, in terms of United States dollars, of the currencies of 32 countries and 52 other areas. In fixing these exchange rates the Fund Agreement requires that "the par value of the currency of each member shall be expressed in terms of gold as a common denominator or in terms of the United States dollar of the weight and fineness in effect on July 1, 1944" (art. IV, sec. 1). The disturbed state of international finance is recognized in the following statement of the executive directors of the Fund, quoted from its First Annual Report:

> We recognize that in some cases the initial par values that are established may later be found incompatible with the maintenance of a balanced international payments position at a high level of domestic economic activity. * * * * When this occurs, the Fund will be faced with new problems of adjustment and will have to recognize the unusual circumstances under which the initial par values were determined. It is just at such times that the Fund can be most useful in seeing that necessary exchange adjustments are made in an orderly manner and competitive exchange depreciation is avoided.

The National Advisory Council Report on Participation of the United States in the Fund and International Bank to October 31, 1946, submitted to the Congress by the President, concludes:

> The Bank and the Fund have now concluded the preliminary phase of their work. The necessary machinery has been set up. The recruitment of staff on a broad international basis is progressing satisfactorily. The Executive Directors have chosen able men as President of the Bank and Managing Director of the Fund. The Bank has called for payment of the member subscriptions to its paid-in capital, and should soon be ready to float securities and make loans. The Fund has announced that it will shortly be in a position to begin exchange operations and has asked the members to communicate the par values of their currencies. It is expected that the Fund will reach agreement with most members on the initial par values of their currencies. In view of the difficult problems which the new organizations have had to face, they have made satisfactory progress in carrying out the plans formulated at Bretton Woods.
>
> From the point of view of the United States, the actions taken and policies adopted by the Bank and the Fund are, in the opinion of the National Advisory Council, satisfactory. On most issues there has been substantial unanimity on the part of the representatives of the member countries. Differences of view have been reconciled by agreement after full discussion in the Boards of Executive Directors. The United States representatives on the Bank and Fund Boards have kept the Council fully informed of all important matters, and have ably represented the American point of view in the international institutions. The good working relations between these representatives and the Council have assured effective implementation of the policies established by the Congress in the Bretton Woods Agreements Act.

DOMESTIC PRODUCTION

Production of gold and silver in the United States is measured at mines and at refineries. Both measures are tabulated by States of origin, but there is a small annual variation between them explained

largely by time lag. Over a period of years the deviations are found to be negligible. Compared with the mine reports compiled by the Bureau of Mines, the refinery reports compiled by the Bureau of the Mint in cooperation with the Bureau of Mines for the 42 years, 1905–46, show a total excess of gold of 186,841 ounces (a difference of 0.13 percent) and a total excess of silver of 11,666,933 ounces (a difference of 0.50 percent).

Gold and silver produced in the United States, 1905–46, in fine ounces, according to mint and mine returns, in terms of recovered metals

Year	Mint		Mine	
	Gold	Silver	Gold	Silver
1905–41	136, 905, 240	2, 167, 735, 394	136, 733, 836	2, 156, 655, 810
1942	3, 741, 806	56, 090, 855	3, 615, 836	54, 321, 962
1943	1, 394, 522	40, 900, 121	1, 377, 579	41, 486, 897
1944	1, 022, 238	35, 651, 049	998, 394	34, 473, 540
1945	928, 893	29, 063, 255	968, 062	29, 024, 197
1946	1, 462, 354	21, 103, 269	1, 574, 505	22, 914, 604
Total	145, 455, 053	2, 350, 543, 943	145, 268, 212	2, 338, 877, 010

MINE PRODUCTION

During the years 1943–45, for the first time on record, over one-half of the domestic gold output was recovered from base-metal ores, but in 1946 both dry ores and placer gravels exceeded base-metal ores in yield of gold. This shift in source of gold resulted partly from re-establishment of production at gold mines (1946 was the first full year of operation free of the restrictions of WPB Order L–208) and partly from prolonged labor strikes that suspended operations at a number of base-metal mines which supply much byproduct gold. WPB Order L–208 had been rescinded effective July 1, 1945, but revival of the gold-mining industry progressed slowly because of high wages, difficulties in recruiting labor forces, and high prices for equipment and supplies, whereas the price of gold remained unchanged. Production during 1946 was less than one-third of the all-time peak established in 1940.

Silver production, which had declined uninterruptedly during the war, reached a new low in 1946, when it dropped to 22,914,604 ounces or to less than in any year (except 1932) since 1872. The labor strikes at copper and lead mines and smelters, where much byproduct silver is recovered, were a major factor in the low output. An analysis of silver production by ores shows that over three-fourths was recovered from base-metal ores in 1946. Moreover, all of the silver recovered at placers and part of that produced from dry ores were byproducts of operations carried on chiefly for gold.

All tonnage figures used in this report are short tons of 2,000 pounds "dry weight"; that is, they do not include moisture. Figures in cubic yards used in measuring material treated in placer operations are "bank measure"; that is, the material is measured in the ground before excavation. The weight unit for gold and silver is the troy ounce (480 grains). The totals are calculated upon the basis of recovered and recoverable fine gold and silver shown by assays to be contained in

ore, bullion, and other material produced. Prices of gold and silver are discussed in a later section of this report.

Mine production of gold and silver in the United States, in 1946, by months, in fine ounces

	Gold	Silver		Gold	Silver
January	95,012	1,937,384	August	172,105	2,219,247
February	87,086	1,667,612	September	189,388	2,145,433
March	96,437	1,666,547	October	161,551	2,139,636
April	92,803	1,299,148	November	152,179	2,238,432
May	115,263	1,418,058	December	155,698	2,825,764
June	113,717	1,445,204			
July	143,266	1,912,139	Total	1,574,505	22,914,604

Mines are grouped into two main classes—placers and lodes. The placers are those in which gold and silver in natural alloy and, in a few placers, platinum are recovered from gravel. Except for such small-scale hand methods as those utilizing the gold pan, the rocker, or the dry washer, all recovery methods employ sluice boxes; methods are distinguished by the means used for delivering the gravel to the sluices. Those methods where gravel is delivered mechanically include connected-bucket dredging, dragline dredging, and treatment in non-floating washing plants of gravel delivered by power shovel, dragline excavator, truck, slackline scraper, or other mechanical means. In the hydraulic method the gravel is mined from the bank by a powerful jet of water; in some small-scale hand methods the gravel is shoveled into sluices; and in drift operations the gravel is mined underground and delivered to sluices at the surface. The lode mines are those yielding gold and silver from ore (as distinguished from gravel), mainly from underground workings and, in addition to those worked chiefly for one or both of the precious metals, include those that yield ore mined chiefly for copper, lead, zinc, or other metals, but contribute the precious metals as byproducts. As far as possible, the mine unit used is not the operator but the mining claim or group of claims.

PRINCIPAL MINING DISTRICTS AND LEADING MINES

One of the anomalies of the war economy was the emergence of a copper district—West Mountain (Bingham), Utah—as the leading gold producer in the United States, surpassing Lawrence County (Lead), S. Dak., in 1943, 1944, and 1945. In 1946, however, Lawrence County regained the lead. The prolonged labor strikes at the mines of the West Mountain district had as much to do with this exchange of places on the list of leading gold districts as did the progressively expanding production of the Lawrence County mines. More than one-third of the domestic mine output was mined in the three leading districts in 1946.

The leading silver districts for many years have included many more noted for base-metal output than silver yield, and this condition was unchanged in 1946.

Mine production of recoverable gold in the United States by districts that produced 10,000 fine ounces or more during any year, 1942–46, in fine ounces [1]

District	State	1942	1943	1944	1945	1946
Lawrence County	South Dakota	520,006	106,444	11,621	55,947	312,246
West Mountain (Bingham)	Utah	327,258	343,551	312,493	248,923	140,877
Folsom	California	109,206	16,065	23,789	32,851	93,718
Yuba River	do	(2)	(2)	(2)	(2)	(2)
Grass Valley-Nevada City	do	155,797	20,605	(2)	31,064	49,033
Cripple Creek	Colorado	104,455	45,105	30,886	28,524	47,640
Robinson (Ely)	Nevada	74,609	64,323	48,120	45,063	39,234
Ajo	Arizona	45,081	45,108	29,020	24,772	33,083
Chelan Lake	Washington	48,364	41,920	26,198	40,207	32,353
Upper San Miguel	Colorado	23,446	20,204	18,542	17,779	24,648
La Grange	California	17,514	4,445	5,018	7,544	(2)
Republic	Washington	24,981	22,638	20,479	17,363	18,563
Oroville	California	50,029	14,533	9,859	4,217	17,891
Tintic	Utah	23,819	22,470	11,417	14,536	17,799
Park City	do	22,935	19,559	15,149	13,822	16,956
Fairplay	Colorado	13,853	8	2	7,338	(2)
Animas	do	17,078	21,188	28,450	21,870	15,905
Camanche	California	17,111	5,071	(2)	(2)	13,933
Manhattan	Nevada	26,397	11,777	7,689	9,870	13,478
Bullion	do	12,989	7,936			12,473
Yellow Pine	Idaho	2,620	5,480	7,753	4,862	10,842
California (Leadville)	Colorado	27,115	23,150	20,149	15,706	10,749
Middle Boise	Idaho	29,491	13,868	4,650	666	9,694
Alleghany	California	11,301	(2)	(2)	(2)	8,477
Verde (Jerome)	Arizona	28,429	18,117	8,620	8,602	8,132
Sumpter	Oregon	13,087	17	13	2,557	8,070
Boise Basin	Idaho	14,412	358	426	1,858	7,758
Mother Lode	California	104,437	16,420	7,140	5,126	7,271
Summit Valley (Butte)	Montana	21,651	16,020	14,441	12,052	6,882
Klamath River	California	21,695	2,629	3,256	(2)	5,853
Warren (Bisbee)	Arizona	58,692	57,042	38,401	15,863	5,680
Cosumnes River	California	15,909	91		389	(2)
Comstock	Nevada	33,162	5,253	3,655	661	5,419
Snelling	California	19,986	81	5	(2)	3,732
Silver City	Nevada	24,025	70		81	2,209
Granite	Oregon	(2)	1	110		2,139
Mojave	California	46,494	1,544	975	223	2,087
East Belt	do	12,662	1,203	598	(2)	1,075
Old Hat	Arizona	26,200	16,185	6,389	471	321
Weaver (Yavapai County)	do	13,301	597	58	49	255
Ophir	California	19,487	510	15	23	50
Mosquito	Colorado	15,009	6,298	622	128	49
Potosi	Nevada	46,625	35,047	(2)	10,752	17
Camp Floyd	Utah	12,463	2,529	1,926	604	
San Francisco (Oatman, Goldroad, Katherine, Vivian)	Arizona	28,570	2,960	21	10	

[1] Exclusive of Alaska.
[2] Bureau of Mines not at liberty to publish.

Of the 25 leading gold-producing mines, 9 were placers worked by connected-bucket dredges, 8 lode gold mines, and 5 base-metal mines; 3 produced more than one type of ore. The 3 leading mines contributed one-third of the total gold produced in the United States in 1946; the 9 leading mines accounted for over one-half; and the list of 25, 64 percent.

Only 4 of the 25 leading silver-producing mines depended exclusively on silver ore; ores valuable chiefly for copper, lead, zinc, and gold accounted for most of the silver production. The 5 leading mines contributed 26 percent of the total silver produced in the United States in 1946; the 10 leading mines, 39 percent; and the list of 25, 60 percent. As several operators worked more than one of the leading silver mines as well as smaller producers, the output of silver by companies was substantially more concentrated than by mines.

Mine production of recoverable silver in the United States by districts that produced 200,000 fine ounces or more during any year, 1942–46, in fine ounces

District	State	1942	1943	1944	1945	1946
Evolution	Idaho	7,341,871	5,745,721	5,211,502	4,348,717	3,098,557
Summit Valley (Butte)	Montana	8,123,334	6,485,123	5,955,608	4,936,770	2,417,422
West Mountain (Bingham)	Utah	5,399,744	5,404,365	4,671,478	3,628,229	2,030,182
Yreka	Idaho	2,458,890	2,237,469	1,811,939	1,485,827	1,536,375
Park City	Utah	2,632,109	2,001,555	1,429,650	1,033,830	1,009,422
Coso (Darwin)	California	53,072	138,662	252,900	575,069	871,091
Warren (Bisbee)	Arizona	2,484,135	2,252,250	1,550,506	963,180	721,135
Tintic	Utah	2,059,193	1,554,989	1,070,214	1,086,435	619,724
Hunter	Idaho	1,085,833	928,378	735,286	581,047	505,000
Warm Springs	do	639,616	715,074	618,947	460,357	418,599
Verde (Jerome)	Arizona	1,532,108	1,036,194	589,538	475,290	418,578
Pioche	Nevada	487,253	408,721	444,309	350,259	403,358
Ajo	Arizona	489,759	478,284	319,320	285,719	390,401
Upper San Miguel	Colorado	314,903	210,763	169,650	274,559	355,604
Creede	do	805,202	630,952	518,161	433,177	355,110
Animas	do	391,794	323,706	228,015	301,957	339,088
Big Bug	Arizona	316,921	244,191	229,490	320,559	338,062
California (Leadville)	Colorado	241,301	379,513	496,634	417,427	332,024
Copper Mountain (Morenci)	Arizona	165,645	195,248	281,153	345,863	265,151
Pioneer (Superior)	do	725,137	476,751	386,429	251,062	243,667
Virginia City	Montana	5,521	2,610	16,020	86,175	236,318
Lelande	Idaho	1,580,026	967,569	521,339	383,476	227,339
Rush Valley	Utah	(1)	(1)	(1)	(1)	(1)
Placer Center	Idaho	368,730	313,716	278,723	196,806	188,948
Robinson (Ely)	Nevada	273,939	254,046	213,663	199,970	151,548
Central	New Mexico	224,914	181,264	216,554	(1)	(1)
Montana	Montana	730,101	196,155	91,409	72,675	120,703
Harshaw	Arizona	343,357	204,404	176,438	144,841	105,672
Bayhorse	Idaho	193,379	211,119	270,644	200,631	84,052
Jack Rabbit	Nevada	242,644	98,474	59,639	48,929	78,760
Tonopah	do	334,712	159,141	91,215	48,434	75,840
Resting Springs	California	210,503	153,540	92,818	(1)	(1)
Red Cliff	Colorado	395,252	176,116	134,211	49,171	57,353
Comstock	Nevada	298,654	123,373	44,065	4,646	50,854
Hog Heaven	Montana	770,206	490,050	93,330	40,500	42,323
Roaring Fork	Colorado	286,131	302,386	126,232	78,362	41,630
Mogollon	New Mexico	210,243	47,368	61,349	91,786	18,187
Grass Valley-Nevada City	California	299,933	103,334	(1)	12,077	11,930
Flint Creek	Montana	526,275	245,447	249,141	208,260	10,255
Mojave	California	589,839	9,658	727	208	8,450
Barker	Montana	215,235	212,625	4,067	5,535	3,588
Carson (French)	Idaho	206,325	793			182
Silver Peak	Nevada	649,206	209,070	696	90	31

[1] Bureau of Mines not at liberty to publish.

25 leading gold-producing mines in the United States in 1946, in order of output

Rank	Mine	District	State	Operator	Source of gold
1	Homestake	Whitewood	South Dakota	Homestake Mining Co	Gold ore.
2	Utah Copper	West Mountain (Bingham)	Utah	Kennecott Copper Corp	Copper ore.
3	Fairbanks Unit	Fairbanks	Alaska	U. S. Smelting, Refining & Mining Co	Dredge.
4	Natomas	Folsom	California	Natomas Co	Do.
5	Yuba Unit	Yuba River	do	Yuba Consolidated Gold Fields	Do.
6	Idaho-Maryland-New Brunswick	Grass Valley-Nevada City	do	Idaho Maryland Mines Corp	Gold ore.
7	New Cornelia	Ajo	Arizona	Phelps Dodge Corp	Copper ore.
8	Holden	Chelan Lake	Washington	Howe Sound Co	Zinc-copper ore.
9	Ruth and Copper Flat Pit	Robinson (Ely)	Nevada	Kennecott Copper Corp	Copper ore.
10	Knob Hill	Republic	Washington	Knob Hill Mines, Inc	Gold ore.
11	Ajax, etc	Cripple Creek	Colorado	Golden Cycle Corp	Do.
12	Park Galena, Mayflower	Blue Ledge	Utah	New Park Mining Co	Gold, zinc-lead ores.
13	Tuolumne Gold Dredge	La Grange	California	Tuolumne Gold Dredging Corp	Dredge.
14	Consolidated Coppermines Group	Robinson (Ely)	Nevada	Consolidated Coppermines Corp	Copper ore.
15	Tintic Bullion	Tintic	Utah	International Smelting & Refining Co	Gold, zinc-lead ores.
16	Capital Dredge	Folsom	California	Capital Dredging Co	Dredge.
17	Portland, Dakota, etc	Portland, Bald Mountain	South Dakota	Bald Mountain Mining Co	Gold ore.
18	Upper and Lower Camanche Units	Camanche	California	Gold Hill Dredging Co	Dredge.
19	Smuggler-Union	Upper San Miguel	Colorado	Telluride Mines, Inc	Gold, gold-silver ores.
20	Manhattan Dredge	Manhattan	Nevada	Manhattan Gold Dredging Co	Dredge.
21	Goldacres	Bullion	do	Willow Creek Mines, Inc., and Consolidated Goldacres Co.	Gold ore.
22	Shenandoah-Dives	Animas	Colorado	Shenandoah-Dives Mining Co	Do.
23	Yellow Pine	Yellow Pine	Idaho	Bradley Mining Co	Do.
24	Lee Andrews, etc	Fairplay	Colorado	South Platte Dredging Co	Dredge.
25	Junction City	Junction City	California	Junction City Mining Co	Do.

25 leading silver-producing mines in the United States in 1946, in order of output

Rank	Mine	District	State	Operator	Source of silver
1	Butte mines	Summit Valley (Butte)	Montana	Anaconda Copper Mining Co	Copper, zinc, zinc-lead ores.
2	Utah Copper	West Mountain (Bingham)	Utah	Kennecott Copper Corp	Copper ore.
3	Sunshine (including Chester Vein)	Evolution	Idaho	Sunshine Mining Co	Silver ore.
4	Darwin group	Coso (Darwin)	California	Anaconda Copper Mining Co	Lead ore.
5	Polaris	Evolution	Idaho	Sunshine Mining Co	Silver ore.
6	United States and Lark	West Mountain (Bingham)	Utah	U. S. Smelting, Refining & Mining Co	Gold-silver, lead, zinc-lead ores.
7	Bunker Hill and Sullivan	Yreka	Idaho	Bunker Hill & Sullivan Mining & Concentrating Co.	Lead, zinc-lead ores.
8	Lincoln, etc	Evolution	do	Sunshine Mining Co. and Silver Dollar Mining Co.	Silver ore.
9	Copper Queen	Warren (Bisbee)	Arizona	Phelps Dodge Corp	Copper, lead-copper, zinc-lead ores.
10	Osburn tailings	Evolution	Idaho	Hecla Mining Co	Zinc-lead ore.
11	Park, Galena, and Mayflower	Blue Ledge	Utah	New Park Mining Co	Gold, zinc-lead ores.
12	United Verde	Verde	Arizona	Phelps Dodge Corp	Copper ore.
13	Triumph	Warm Springs	Idaho	Triumph Mining Co	Zinc-lead ore.
14	New Cornelia	Ajo	Arizona	Phelps Dodge Corp	Copper ore.
15	Page	Yreka	Idaho	Federal Mining & Smelting Co	Zinc-lead ore.
16	Commodore, etc	Creede	Colorado	Emperius Mining Co	Silver ore.
17	Iron King	Big Bug	Arizona	Shattuck Denn Mining Corp	Zinc-lead ore.
18	Chief, Gemini, etc	Tintic	Utah	Chief Consolidated Mining Co	Silver, lead, zinc-lead ores.
19	Park Utah	Uintah	do	Park Utah Consolidated Mining Co	Zinc-lead ore.
20	Morenci	Copper Mountain	Arizona	Phelps Dodge Corp	Copper ore.
21	Pioche group	Pioche	Nevada	Combined Metals Reduction Co. & Raymond Ely West Mining Co.	Zinc-lead ore.
22	U. S. Grant	Virginia City	Montana	W. H. Myers	Gold-silver ore.
23	Magma	Pioneer	Arizona	Magma Copper Co	Copper ore.
24	Silver King	Uintah	Utah	Silver King Coalition Mines Co	Silver, lead, zinc-lead ores.
25	Morning	Hunter	Idaho	Federal Mining & Smelting Co	Zinc-lead ore.

Mine production of recoverable gold in the United States, 1936–46, with production of maximum year, and cumulative production from earliest record to end of 1946, by States, in fine ounces

	Maximum production [1]		Production by years											Total production from earliest record to end of 1946
	Year	Quantity	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	
Western States and Alaska:														
Alaska	1906	1,066,030	540,580	627,940	664,973	676,737	755,970	695,467	487,621	99,583	49,296	68,117	226,781	26,083,428
Arizona	1937	332,694	322,408	332,694	305,043	316,453	294,807	315,392	253,651	171,810	112,162	77,223	79,024	10,868,159
California	1852	3,932,631	1,077,442	1,174,578	1,311,129	1,435,264	1,455,671	1,408,793	847,997	148,328	117,373	147,938	356,824	101,881,219
Colorado	1900	1,391,364	366,607	368,905	367,468	366,852	367,336	380,029	268,627	137,558	111,455	100,935	142,613	39,057,943
Idaho	1871	212,850	80,291	81,861	103,513	116,662	146,480	149,816	95,020	30,808	25,008	17,780	42,975	7,840,749
Montana	1865	870,750	180,209	202,252	203,313	264,173	272,602	246,475	146,892	59,586	50,021	44,597	70,507	17,052,121
Nevada	1910	913,265	286,370	281,332	296,434	361,518	383,933	366,403	295,112	144,442	119,056	92,265	90,680	25,517,001
New Mexico	1915	70,681	33,037	41,171	43,050	36,979	35,943	27,845	11,961	5,563	6,918	5,604	4,009	2,182,835
Oregon	1940	113,402	60,753	52,662	81,729	93,372	113,402	96,565	46,233	1,097	1,369	4,467	17,598	5,691,552
South Dakota	1939	618,536	586,353	581,544	594,847	618,536	586,662	600,637	522,098	106,444	11,621	55,948	312,247	21,046,301
Texas	1929	1,279	613	562	439	324	312	306	236	4	----------	----------	9	8,290
Utah	1942	391,544	223,444	322,759	200,630	277,751	355,494	356,501	391,544	390,470	344,223	279,979	178,533	10,642,978
Washington	1939	90,420	12,218	36,310	74,175	90,420	82,136	84,176	75,396	65,244	47,277	57,860	51,168	2,178,670
Wyoming	1869	7,498	1,965	1,776	798	583	740	478	23	----------	20	2	105	78,041
Total	------	----------	3,772,290	4,106,346	4,247,541	4,655,624	4,851,488	4,728,883	3,442,411	1,360,937	995,799	952,715	1,573,073	270,129,287
Central States:														
Indiana	(2)	(2)	----------	----------	----------	4	5	----------	----------	----------	----------	----------	----------	(3)
Michigan	1890	4,354	----------	51	----------	----------	----------	----------	----------	----------	----------	----------	----------	33,297
Missouri	1900	33	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	33
Total	------	----------	----------	51	----------	4	5	----------	----------	----------	----------	----------	----------	33,330
Eastern States:														
Alabama	1936	4,726	4,726	2,460	41	3	5	30	1	----------	----------	5	1	49,495
Georgia	1882	12,094	450	743	872	670	961	311	30	12	5	----------	21	870,547
Maryland	1937	1,040	668	1,040	855	71	----------	----------	----------	----------	----------	----------	----------	6,102
North Carolina	1887	10,884	2,037	949	1,878	495	1,943	3,244	4,077	131	21	----------	----------	1,164,588
Pennsylvania	1942	2,499	890	1,348	1,422	1,815	1,840	2,422	2,499	2,218	2,115	1,588	1,150	[4] 25,284
South Carolina	1941	15,508	287	2,482	11,681	13,833	13,076	15,508	7,824	147	----------	----------	----------	318,801
Tennessee	1930	696	410	263	236	163	173	227	159	303	222	148	95	20,965
Vermont	1946	165	----------	----------	----------	----------	----------	----------	----------	17	100	104	165	[5] 419
Virginia	1938	2,943	909	1,396	2,943	364	458	240	109	50	132	12	----------	167,558
Total	------	----------	10,377	10,681	19,928	17,414	18,456	21,982	14,699	2,878	2,595	1,857	1,432	2,623,759
Grand total	------	----------	3,782,667	4,117,078	4,267,469	4,673,042	4,869,949	4,750,865	3,457,110	1,363,815	998,394	954,572	1,574,505	272,786,376

[1] For Central and Eastern States figures are peaks since 1880, except Pennsylvania and Vermont, for which the figures are peaks since 1905. For Alaska, Nevada, and Oregon figures are likewise peaks since 1880 only.
[2] Figure not available.
[3] Small; figure not available.
[4] 1908–46 only.
[5] 1905–46 only.

Mine production of recoverable silver in the United States, 1936–46, with production of maximum year, and cumulative production from earliest record to end of 1946, by States, in fine ounces

	Maximum production [1]		Production by years											Total production from earliest record to end of 1946
	Year	Quantity	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	
Western States and Alaska:														
Alaska	1916	1,379,171	484,306	494,340	479,853	201,054	191,679	191,522	119,704	42,788	13,362	9,983	41,793	19,790,298
Arizona	1937	9,422,552	8,386,043	9,422,552	7,479,153	7,824,004	7,075,215	7,498,260	7,064,467	5,713,889	4,394,039	3,558,216	3,268,765	292,687,414
California	1924	3,629,223	2,103,799	2,888,265	2,590,804	2,599,139	2,359,776	2,154,188	1,450,440	609,075	778,936	986,798	1,342,651	108,200,088
Colorado	1892	26,632,300	5,902,776	6,260,693	7,932,095	8,496,488	9,710,709	7,301,697	3,096,211	2,664,142	2,248,830	2,226,780	2,240,151	730,426,678
Idaho	1937	19,587,766	14,537,530	19,587,766	18,993,676	17,222,370	17,552,240	16,672,410	14,644,890	11,700,180	9,931,614	8,142,667	6,491,104	520,485,412
Montana	1892	19,038,800	11,600,563	11,812,093	6,403,962	9,087,571	12,361,050	12,386,925	11,188,118	8,450,370	7,093,215	5,942,070	3,273,140	749,149,823
Nevada	1913	16,090,083	5,068,786	4,864,750	4,355,471	4,316,029	5,175,928	5,830,238	3,723,435	1,620,280	1,259,636	1,043,380	1,250,651	589,603,712
New Mexico	1885	2,343,800	1,163,255	1,243,766	1,229,860	1,400,878	1,407,839	1,328,317	676,170	463,583	535,275	465,127	338,000	67,754,731
Oregon	1941	276,158	85,061	60,564	100,507	105,388	219,112	276,158	87,376	10,523	20,243	10,461	6,927	5,225,312
South Dakota	1900	536,200	144,448	139,638	162,295	167,584	175,514	170,771	186,937	35,886	5,445	26,564	86,901	9,688,009
Texas	1938	1,433,008	1,361,459	1,325,660	1,433,008	1,341,945	1,326,150	1,096,027	672,781	10,284	5,355	23,265	42,922	33,268,363
Utah	1925	21,276,689	9,997,645	12,869,117	9,682,732	10,758,657	12,172,299	11,395,485	10,574,955	9,479,340	7,593,075	6,106,545	4,118,453	719,172,519
Washington	1902	721,450	66,900	126,304	380,938	442,063	365,175	402,030	369,038	370,440	321,608	281,444	264,453	12,829,873
Wyoming	1901	21,400	1,113	203	328	75	114	94	52		3	31	26	74,692
Total			60,903,684	71,095,711	61,224,682	63,963,245	70,092,800	66,704,122	53,854,574	41,170,780	34,200,636	28,823,331	22,765,937	3,858,356,924
Central States:														
Illinois	1924	8,891	1,780	887	576	675	4,766	[2] 8,138	104	2,153	2,437	2,198	2,302	137,342
Michigan	1916	716,640		25,454	93,634	101,878	88,657	60,796	61,674	48,479	54,218	21,863		10,253,023
Missouri	1938	292,000	163,720	179,700	292,000	213,400	[2] 147,306	[2] 169,027	69,106	111,285	92,243	94,822	69,401	4,161,997
Total			165,500	206,041	386,210	315,953	[2] 240,729	[2] 237,961	130,884	161,917	148,898	118,883	71,703	14,552,362
Eastern States:														
Alabama	1936	869	869	457	4		3	3				1		5,239
Georgia	1904	1,500	28	49	71	58	630	38	7					10,947
Maryland	1917	1,092	33	40	24	2								2,595
New York	1937	41,500	18,251	41,500	37,200	37,250	35,720	37,734	40,012	38,004	25,238	14,271	15,786	389,122
North Carolina	1906	30,769	5,575	5,538	5,500	3,961	6,480	7,439	8,259	7,169	1,461			357,223
Pennsylvania	1942	15,501	8,118	9,497	9,360	13,558	13,064	15,016	15,501	13,095	13,545	10,434	7,887	181,554
South Carolina	1940	8,047	50	624	3,951	5,480	8,047	6,525	5,064	135				35,325
Tennessee	1920	110,719	50,330	49,057	38,333	31,994	38,610	39,161	34,671	52,058	45,907	35,391	18,016	3,038,350
Vermont	1946	35,275								2,721	18,862	20,586	35,275	[3] 104,052
Virginia	1944	18,993	96	111	502	1,780	271	135	1,793	14,947	18,993	1,300		79,389
Total			83,350	106,873	94,945	94,083	102,825	106,051	105,307	128,129	124,006	81,983	76,964	4,203,796
Grand total			61,152,534	71,408,625	61,705,837	64,373,281	[2] 70,436,354	[2] 67,048,134	54,090,765	41,460,826	34,473,540	29,024,197	22,914,604	3,877,113,082

[1] Eastern States figures are peaks since 1896, except New York and Pennsylvania which are peaks since 1905. The Illinois figure is the peak since 1907. Alaska, California, Nevada, and Oregon are peaks since 1880.

[2] Revised figure.

[3] Includes a small quantity by New Hampshire.

ORE PRODUCTON, CLASSIFICATION, METAL YIELD, AND METHODS OF RECOVERY

The following tables give details of classes of ore, metal yield in fine ounces of gold and silver to the ton, and gold and silver output by classes of ore and by methods of recovery, embracing all ores that yielded gold and silver in the United States (excluding the Philippine Islands and Puerto Rico) in 1946. These tables were compiled from the individual State chapters in this volume, in which more detailed data are presented.

The classification originally adopted in 1905 on the basis of smelter terminology, smelter settlement contracts, and smelter recovery has been used continuously in succeeding years, except for modifications necessitated by the improvement in recovery of metals and the lowering of grade of complex ores treated, accomplished by improved mill concentration processes. A "dry" ore is one that carries so little base metal that by itself it would not satisfy the requirements for a smelter charge as in either lead or copper smelting. The copper ores include those smelting ores that contain 2.5 percent dry assay or more of copper (or less than this percentage if no other metal is present); or those ores concentrated chiefly for their copper content. The lead ores are those that contain 5 percent dry assay (minimum lead smelting charge requires 7.5 to 8.5 percent wet assay) or more of lead, irrespective of precious-metal content; an ore that carries any grade of lead exclusively is called a lead ore. Zinc smelting ores (chiefly oxides) range from 16 to 45 percent zinc; zinc concentrating ores include any grade of zinc ore that makes marketable zinc concentrate, irrespective of precious-metal content. The mixed ores are combinations of those enumerated. The smelter classification applies to concentrates.

Ore produced in the United States and average recovery, in fine ounces, of gold and silver per ton in 1946 [1]

State	Gold ore			Gold-silver ore			Silver ore		
	Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton	
		Gold	Silver		Gold	Silver		Gold	Silver
Western States and Alaska:									
Alaska	8,979	[2] 0.483	[2] 0.098						
Arizona	25,613	.090	.289	13,327	0.074	3.812	14,154	0.019	7.618
California	331,771	.234	.092	3,199	.535	13.986	687	.010	3.473
Colorado	507,997	.143	.309	293,907	.113	2.168	39,829	.008	12.468
Idaho	163,666	.103	.643	126	.873	31.667	92,209	.001	28.309
Montana	113,653	.210	.277	19,147	.184	13.545	16,811	.028	9.645
Nevada	312,344	.088	.275	8,148	.145	11.432	9,083	.019	7.000
New Mexico	512	1.361	1.805	10,557	.065	2.592	159		9.635
Oregon	3,069	.353	.753	1	7.000	377.000	24	.250	39.750
South Dakota	872,242	.358	.100						
Texas							2,054		20.107
Utah	3,990	3.816	4.301	41,269	.074	4.431	34,616	.022	5.365
Washington	51,622	.362	2.002						
Wyoming	42	2.095	.310						
Total	2,395,500	.239	.263	389,681	.114	3.336	209,626	.010	17.519
Eastern States									
Total	2,395,500	.239	.263	389,681	.114	3.336	209,626	.010	17.519

See footnotes at end of table.

Ore produced in the United States and average recovery, in fine ounces, of gold and silver per ton in 1946 [1]—Continued

State	Copper ore			Lead ore			Lead-copper ore		
	Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton	
		Gold	Silver		Gold	Silver		Gold	Silver
Western States and Alaska:									
Alaska				1,819	0.038	3.846			
Arizona	30,386,149	0.002	0.058	13,441	.041	3.061	1,066	0.068	20.531
California	86,297	.004	.194	57,330	.022	16.690			
Colorado	8,292	.016	4.376	19,307	.097	2.067	5	.600	15.400
Idaho	903	.066	1.203	113,175	.001	2.335	119	.008	152.555
Montana	1,781,895	.007	1.169	5,857	.108	6.020			
Nevada	5,102,212	.008	.057	14,468	.026	13.583			
New Mexico	6,044,004		.017	737	.243	4.799			
Oregon	152		.375						
South Dakota									
Texas	80		.225	221	.032	3.679			
Utah	12,471,208	.011	.099	11,700	.111	6.570	1,236	.252	40.146
Washington	43	.070	8.116	6,920	.002	2.086			
Wyoming	19		.526						
Total	55,881,254	.005	.099	244,975	.026	6.681	2,426	.160	36.990
Eastern States	1,139,692		.047	1,600					
Total	57,020,946	.004	.098	246,575	.026	6.637	2,426	.160	36.990

State	Zinc ore			Zinc-lead, zinc-copper, and zinc-lead-copper ores			Total ore		
	Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton	
		Gold	Silver		Gold	Silver		Gold	Silver
Western States and Alaska:									
Alaska							10,798	0.408	0.729
Arizona	13,233	0.008	0.929	591,196	0.022	2.136	31,058,179	.003	.105
California	45,043	.073	2.971	103,440	.006	1.112	[3] 627,767	[3] .136	[3] 2.071
Colorado	172,320	.012	.682	421,839	.029	1.782	1,463,496	.084	1.528
Idaho	[4] 104,585		.379	2,407,404	.002	1.430	2,882,187	.008	2.250
Montana	[5] 73,727	.001	.227	223,868	.011	3.040	2,234,958	.019	1.462
Nevada	11,306	.009	1.534	268,244	.012	1.858	5,725,805	.013	.217
New Mexico	487,063	.002	.289	51,858	.002	1.227	6,594,890	.001	.051
Oregon							3,246	.338	1.139
South Dakota							872,242	.358	.100
Texas	4,350		.182				6,705	.001	6.401
Utah	[6] 105,222	.003	.514	576,450	.042	4.016	13,245,691	.013	.311
Washington	39,634		.018	759,804	.043	.192	858,023	.060	.308
Wyoming							61	1.443	.377
Total	1,056,483	.006	.505	5,404,103	.017	1.716	65,584,048	.015	.346
Eastern States	1,342,233			752,475		.021	[7] 3,236,000		.024
Total	2,398,716	.003	.222	6,156,578	.015	1.509	68,820,048	.014	.330

[1] Illinois, Missouri, Philippine Islands, and Puerto Rico excluded.
[2] Excludes gold and silver recovered from mill clean-up; no ore mined.
[3] Excludes pyritic ore used for acid manufacture and tungsten ore and gold and silver recovered from these materials.
[4] Includes 92,072 tons of lead smelter slag.
[5] Includes 55,458 tons of old lead smelter slag fumed and 232 tons of old lead smelter slag smelted.
[6] Includes 83,117 tons of zinc slag.
[7] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.

Gold, gold-silver, and silver ores containing too little copper, lead, or zinc to be classified as copper, lead, zinc, or mixed ores are called "dry" ores regardless of the ratio of concentration, except low-grade ore milled chiefly for its copper content and having very little or no precious-metal content (chiefly, the "porphyry coppers") and ores from which separate products of lead concentrates and zinc concentrates are made. The crude ore into the mill in these two exceptional instances thus takes it name from its products—a name that is also justified by the mineralogical content and final recovery of metals. The "dry ores" thus, by elimination, include ores, chiefly siliceous, valuable for their gold and silver content and, in some instances, for their fluxing properties, regardless of method of treatment. Dry gold ores are those that by inspection are overwhelmingly of gold content; a similar qualification applies to silver ores; decision as to "gold-silver" ore is made on a basis of value, using the rule that the bimetal classification is not used unless the metal of lower value equals or exceeds one-quarter of the combined value of the gold and silver.

The lead, zinc, and zinc-lead ores in most districts in the Eastern and Central States carry no appreciable quantity of gold or silver; such ores are excluded from this report unless otherwise indicated.

Mine production of gold in the United States, 1942–46, by percent from sources and in total fine ounces [1]

Year	Percent from—						Total fine ounces
	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Zinc-lead, zinc-copper, lead-copper, and zinc-lead-copper ores	
1942	29.3	50.0	17.0	0.7	(2)	2.9	3,457,110
1943	11.6	38.3	39.5	1.1	0.3	9.2	1,363,815
1944	12.4	29.8	45.4	.9	.8	10.7	998,394
1945	19.3	29.9	37.5	.6	.7	12.0	954,572
1946	37.5	39.5	16.1	.4	.4	6.1	1,574,505

[1] Philippine Islands and Puerto Rico excluded.
[2] Less than 0.1 percent.

Mine production of silver in the United States, 1942–46, by percent from sources and in total fine ounces [1]

Year	Percent from—						Total fine ounces
	Placers	Dry and siliceous ore	Copper ore	Lead ore	Zinc ore	Zinc-lead, zinc-copper, lead-copper, and zinc-lead-copper ores	
1942	0.3	37.3	27.8	5.5	1.2	28.0	54,090,765
1943	(2)	26.1	33.7	8.1	1.2	31.0	41,460,826
1944	(2)	17.1	34.4	12.0	2.2	34.3	34,473,540
1945	.1	24.3	31.4	4.4	2.0	37.8	29,024,197
1946	.3	24.4	24.4	7.5	2.3	41.1	22,914,604

[1] Philippine Islands and Puerto Rico excluded.
[2] Less than 0.1 percent.

Mine production of gold in the United States in 1946, by States and sources, in fine ounces, in terms of recovered metals [1]

State	Placers	Dry and siliceous ore	Copper ore	Lead ore	Lead-copper ore	Zinc ore	Zinc-lead, zinc-copper, and zinc-lead-copper ores	Total
Alabama	1							1
Alaska	220,708	6,003		70				226,781
Arizona	398	3,564	61,347	546	73	111	12,985	79,024
California	269,772	79,883	311	1,275		3,271	[2] 2,312	356,824
Colorado	20,172	106,007	131	1,880	3	2,093	12,327	142,613
Georgia	21							21
Idaho	20,123	17,027	60	107	1	40	5,617	42,975
Montana	27,986	27,802	11,590	634		68	2,427	70,507
Nevada	14,786	28,973	43,260	371		103	3,187	90,680
New Mexico	10	1,384	1,566	179		743	127	4,009
Oregon	16,502	1,096						17,598
Pennsylvania			[3] 1,150					1,150
South Dakota		312,247						312,247
Tennessee			95					95
Texas		1		7		1		9
Utah	7	19,075	133,454	1,300	312	357	24,028	178,533
Vermont			165					165
Washington	101	18,686	3	12		6	32,360	51,168
Wyoming	17	88						105
Total	590,604	621,836	253,132	6,381	389	6,793	95,370	1,574,505

[1] Philippine Islands and Puerto Rico excluded.
[2] Includes gold recovered from pyritic ore and tungsten ore.
[3] From magnetite-pyrite-chalcopyrite ore.

Mine production of silver in the United States in 1946 by States and sources, in fine ounces, in terms of recovered metals [1]

State	Placers	Dry and siliceous ore	Copper ore	Lead ore	Lead-copper ore	Zinc ore	Zinc-lead, zinc-copper, and zinc-lead-copper ores	Total
Alaska	33,656	1,141		6,996				41,793
Arizona	62	166,044	1,764,558	41,137	21,886	12,294	1,262,784	3,268,765
California	19,821	77,708	16,736	956,860		133,841	[2] 137,685	1,342,651
Colorado	3,698	1,290,723	36,286	39,911	77	117,607	751,849	2,240,151
Idaho	6,422	2,719,762	1,086	264,279	18,154	39,614	3,441,787	6,491,104
Illinois				35			2,267	2,302
Missouri				67,734	1,667			69,401
Montana	5,354	452,930	2,082,321	35,259		16,750	680,526	3,273,140
Nevada	5,982	242,709	289,701	196,518		17,339	498,402	1,250,651
New Mexico	2	29,824	100,318	3,537		140,674	63,645	338,000
New York							15,786	15,786
Oregon	3,229	3,641	57					6,927
Pennsylvania			[3] 7,887					7,887
South Dakota		86,901						86,901
Tennessee			18,016					18,016
Texas		41,300	18	813		791		42,922
Utah		385,747	1,237,060	76,870	49,620	54,056	2,315,100	4,118,453
Vermont			35,275					35,275
Washington	21	103,369	349	14,433		708	145,573	264,453
Wyoming	3	13	10					26
Total	78,250	5,601,812	5,589,678	1,704,382	91,404	533,674	9,315,404	22,914,604

[1] Philippine Islands and Puerto Rico excluded.
[2] Includes silver recovered from pyritic ore and tungsten ore.
[3] From magnetite-pyrite-chalcopyrite ore.

Gold and silver produced in the United States from ore and old tailings, in 1946, by States and by methods of recovery, in terms of recovered metals [1]

State	Total ore, old tailings, etc. treated (short tons)	Ore and old tailings to amalgamation and cyanidation mills and bullion recovered			Ore and old tailings to concentrating mills (short tons)	Concentrates smelted (from amalgamation, cyanidation, and concentrating mills combined)			Crude ore to smelters		
		Short tons	Gold (fine ounces)	Silver (fine ounces)		Short tons	Gold (fine ounces)	Silver (fine ounces)	Short tons	Gold (fine ounces)	Silver (fine ounces)
Western States and Alaska:											
Alaska	10,798	8,439	[2] 5,519	[2] 956	2,358	247	554	7,136	1		45
Arizona	[3] 28,089,138	23,588	1,083	6,856	27,593,067	1,008,835	62,422	2,493,508	[4] 483,334	15,121	768,339
California	[5] 627,767	370,676	73,210	24,762	186,451	38,181	8,896	331,954	70,640	4,946	966,114
Colorado	1,463,496	360,750	61,321	14,322	1,077,577	134,720	57,594	2,080,460	25,169	3,526	141,671
Idaho	2,882,187	15,707	2,919	1,766	2,757,813	233,364	18,811	6,357,673	108,667	1,122	125,243
Montana	2,234,958	99,479	14,683	7,612	2,005,486	323,005	16,078	2,759,887	74,535	11,760	492,787
Nevada	5,725,805	306,795	22,213	73,279	5,303,641	234,821	46,128	666,415	115,369	7,553	504,975
New Mexico	6,594,890	135	17	6	6,522,646	250,092	1,810	244,536	72,109	2,172	93,456
Oregon	3,246	2,799	363	644					447	733	3,054
South Dakota	872,242	872,242	312,247	86,901							
Texas	6,705				4,350	127	1	791	2,355	8	42,131
Utah	13,245,691				13,055,452	453,026	156,610	3,473,187	190,239	21,916	645,266
Washington	858,023	[6] 44,217	13,758	61,077	806,147	47,034	35,488	190,008	8,769	1,821	13,347
Wyoming	61								61	88	23
Total	62,615,007	2,104,827	507,333	278,181	59,314,988	2,723,452	404,392	18,605,555	1,151,695	70,766	3,796,451
Eastern States	[7] 3,236,000				[7] 3,110,760	[8] 74,319	1,410	76,964	125,240		
Total	65,851,007	2,104,827	507,333	278,181	62,425,748	2,797,771	405,802	18,682,519	1,276,935	70,766	3,796,451

[1] Illinois, Missouri, Philippine Islands, and Puerto Rico excluded.
[2] Includes gold and silver from mill clean-up; no ore mined in 1946.
[3] Excludes 2,969,041 tons of copper ore leached from which no gold or silver was recovered.
[4] Includes 10,851 tons of copper precipitates from which silver was recovered.
[5] Excludes tungsten ore from which copper concentrates containing gold and silver were recovered.
[6] Includes 1,110 tons of flotation concentrates cyanided.
[7] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.
[8] Excludes concentrates that yielded no gold and silver.

Gold and silver produced at amalgamation and cyanidation mills in the United States and percentage of gold and silver recovered from all sources, 1942–46 [1]

Year	Bullion and precipitates recovered (fine ounces)				Percent of gold and silver from all sources [1]							
	Amalgamation		Cyanidation		Amalgamation		Cyanidation		Smelting [2]		Placers	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1942	623,319	140,192	698,817	3,008,490	18.0	0.2	20.2	5.6	32.5	93.9	29.3	0.3
1943	168,772	44,114	143,092	420,528	12.4	.1	10.5	1.0	65.5	98.9	11.6	[3]
1944	73,974	18,067	76,266	91,009	7.4	[3]	7.6	.3	72.6	99.7	12.4	[3]
1945	85,450	17,024	89,350	77,088	9.0	[3]	9.4	.3	62.3	99.6	19.3	.1
1946	278,293	54,255	229,040	223,926	17.7	.3	14.5	1.0	30.3	98.4	37.5	.3

[1] Illinois, Michigan, Missouri, Philippine Islands, and Puerto Rico excluded.
[2] Both crude ores and concentrates.
[3] Less than 0.1 percent.

Gold and silver produced at amalgamation and cyanidation mills in the United States in 1946, by States [1]

State	Amalgamation			Cyanidation			Percent of gold and silver from all sources in State			
	Ore, old tailings, concentrates, etc. treated (short tons)	Bullion recovered (fine ounces)		Ore, old tailings, concentrates, etc. treated (short tons)	Bullion and precipitates recovered (fine ounces)		Amalgamation		Cyanidation	
		Gold	Silver		Gold	Silver	Gold	Silver	Gold	Silver
Western States and Alaska:										
Alaska	8,439	[2] 5,519	[2] 956				2.43	2.29		
Arizona	83	194	33	23,505	889	6,823	.25		1.12	0.21
California	361,410	45,838	8,355	24,939	27,372	16,407	12.85	.62	7.67	1.22
Colorado	342,976	21,519	4,769	[3] 305,735	39,802	9,553	15.09	.21	27.91	.43
Idaho	15,707	2,919	1,766				6.79	.03		
Montana	17,439	2,740	1,438	82,040	11,943	6,174	3.89	.04	16.94	.19
Nevada	3,502	1,915	1,397	303,293	20,298	71,882	2.11	.11	22.38	5.75
New Mexico	135	17	6				.42			
Oregon	167	207	37	2,632	156	607	1.18	.53	.89	8.76
South Dakota	793,034	197,425	35,498	862,311	114,822	51,403	63.23	40.85	36.77	59.15
Washington				[4] 44,217	13,758	61,077			26.89	23.10
Total	1,542,892	278,293	54,255	1,648,672	229,040	223,926	17.67	.24	14.55	.98
Eastern States										
Total	1,542,892	278,293	54,255	1,648,672	229,040	223,926	17.67	.24	14.55	.98

[1] Illinois, Missouri, Philippine Islands, and Puerto Rico excluded.
[2] Includes gold and silver recovered from mill clean-up.
[3] Comprises 303,777 tons of sand and slimes from ore first roasted and amalgamated and 1,958 tons of selective-flotation tailings.
[4] Includes 1,110 tons of flotation concentrates cyanided.

PLACERS

Most of the placer gold output is obtained from gravels handled by connected-bucket floating dredges. In 1946 this method accounted for 80 percent of the total output from placers in the United States compared with 84 percent in 1945 and 83 percent in 1944. The quantity of gold recovered by dredges from the inception of the industry as a commercial factor in 1896 to the end of 1946 is recorded as 19,910,593 ounces, originating by States as follows: California, 12,031,837 ounces; Alaska, 5,386,617 (including the production from single-dipper dredges and some gold by hydraulicking); Montana, 739,034; Idaho, 631,312; Oregon, 484,602; Colorado, 473,182; other States, 164,009.

The accompanying table shows the gold produced in the United States by connected-bucket floating dredges in 1942–46.

Additional information on placer mining may be found in the State reviews in this volume.

Gold produced in the United States by connected-bucket floating dredges, 1942–46, in fine ounces

Year	Number of dredges	California	Alaska	Other States [1]	Total
1942	102	310,937	249,868	128,264	689,069
1943	21	66,999	18,554	24,373	109,926
1944	17	64,925	26,280	10,774	101,979
1945	36	88,318	34,885	31,269	154,472
1946	73	244,679	148,834	76,632	470,145

[1] Colorado, Idaho, Montana, Nevada, and Oregon.

REFINERY PRODUCTION

Figures in the following table were obtained through cooperation between the United States Bureau of the Mint and the Bureau of Mines. The State totals are based upon bullion deposits in the United States mints and assay offices and upon returns to the Bureau of the Mint from smelting and refining companies. The State distribution is adjusted further by the Bureau of Mines from its geographical records of sources and production (both historical and current) from the producing mines and is tabulated from the mine reports. The data for the total production and in part for the distribution are obtained from records of (1) the unrefined domestic gold and silver deposited in the United States mints and assay offices; (2) the domestic gold and silver in fine bars reported by private refineries, supplemented by data of content of unrefined mattes, blister copper, copper anodes, and lead bullion; and (3) the unrefined domestic gold and silver contained in ore and matte exported for reduction. The last item is small.

Gold and silver produced in the United States,[1] 1942–46, and approximate distribution of source, by States and Territories, in 1946, in fine ounces

[Refinery figures supplied by U. S. Bureau of the Mint]

State or Territory	Gold	Silver
1942	3,741,806	56,090,855
1943	1,394,522	40,900,121
1944	1,022,238	35,651,049
1945	928,893	29,063,255
1946:		
Alabama	1	(2)
Alaska	192,303	36,221
Arizona	70,498	2,991,406
California	349,970	1,195,765
Colorado	129,604	2,040,874
Georgia	21	(2)
Idaho	30,340	6,218,895
Illinois		2,288
Missouri		68,430
Montana	62,350	2,747,700
Nevada	89,924	1,339,421
New Mexico	9,152	477,021
New York		15,727
Oregon	16,961	8,290
Pennsylvania	1,178	8,123
South Dakota	307,647	89,017
Tennessee	72	17,716
Texas	10	33,610
Utah	152,228	3,530,855
Vermont	150	32,369
Virginia	12	835
Washington	49,911	248,694
Wyoming	22	12
Total	1,462,354	21,103,269

[1] Includes all production for United States and possessions 1942–45; Philippine Islands production for 1946 excluded.
[2] Less than 1 ounce.

Gold and silver produced in the United States, 1792–1946 [1]

Period	Gold		Silver	
	Fine ounces	Value [2]	Fine ounces	Value [3]
1792–1847	1,187,170	$24,537,000	309,500	$404,500
1848–1873	60,021,278	1,240,750,000	146,218,600	193,631,500
1874–1946	214,766,542	5,114,368,745	3,765,589,843	2,811,484,112
Total	275,974,990	6,379,655,745	3,912,117,943	3,005,520,112

[1] From Report of the Director of the Mint. The estimates for 1792–1873 are by R. W. Raymond, Commissioner of Mining Statistics, Treasury Department, and since then, by the Director of the Mint.
[2] Gold valued in 1934 and thereafter at $35 per fine ounce; prior thereto, at $20.67+ per fine ounce.
[3] Silver valued in 1934 and thereafter at Government's average buying price for domestic product.

CONSUMPTION AND USES IN INDUSTRY AND THE ARTS

Monetary use has claimed by far the largest part of the gold and silver output through the years, but this use to a large extent takes the form of stock-piling in Government and private hoards which are available to industry and the arts without smelter or refinery preparation. In contrast, the gold and silver entering industry and the arts are consumed much as are other metals, any return as secondary metal requiring the usual channels of collection, smelting, and refining. The consumption of gold and silver in the arts antedates written history,

but industrial use of these two metals is a comparatively recent development.

Gold.—The arts require a much larger quantity of gold than does industry, but its corrosion-resistant and other properties have resulted in some industrial demand. Consumption in the arts increased rapidly during the war. A high marriage rate and widespread prosperity have increased the sale of jewelry, watches, and many luxury items made from gold.

A most interesting new use for gold was reported during 1946 in connection with spectrography. In spectrographic work the mercury lines have been widely used for reference, but because natural mercury is made up of six or seven isotopes the lines are not sharply defined. Recent atomic physics has effected the transmutation of gold to mercury; because native gold has no prominent isotopes, the mercury thus created is preeminently a single isotope, and its spectrographic lines are very sharp. The dream of the alchemists, but in reverse, thus has been realized in this boon to spectrographers.

Net industrial consumption of gold and silver in the United States, 1942–46

[U. S. Bureau of the Mint]

Year	Gold (dollars)			Silver (fine ounces)		
	Returned from industrial use	Issued for industrial use	Net industrial consumption	Returned from industrial use	Issued for industrial use	Net industrial consumption
1942	$28,447,685	$75,742,495	$47,294,810	30,020,529	131,419,224	101,398,695
1943	10,521,000	96,864,353	86,343,353	44,112,863	162,112,863	118,000,000
1944	25,678,940	122,977,223	97,298,283	56,189,409	176,289,409	120,100,000
1945	30,991,905	139,936,237	108,944,332	58,360,767	184,660,767	126,300,000
1946	45,999,837	199,686,837	153,687,000	36,646,860	123,646,860	87,000,000

Silver.—The 1946 consumption of silver in industry and the arts was well below that in the preceding war years but nevertheless was greatly above the prewar level. The consumption exceeded any annual output ever achieved by domestic mines. Moreover, consumption would probably have been larger had it not been for the difficulty in obtaining supplies during the first half of the year. Until its expiration, December 31, 1945, the Green Act made Treasury silver available to domestic silver consumers at the ceiling price set by the OPA of 71.11+ cents an ounce. When the Green Act was not renewed, the consumers had to enter a controlled market where the OPA barred transactions at prices exceeding the 71.11+-cent ceiling. Domestically produced silver was available at the ceiling price but could not supply much more than about a quarter of the demand. Foreign suppliers, foreseeing the possibilities of a higher price, withheld their silver. Very large purchases from the Treasury in November and December 1945 under the Green Act helped to meet the needs but some users were driven to the use of monetized silver at $1.29+ an ounce. Meanwhile, a contest developed in Congress between those advocating a reenactment of the Green Act and those who favored pricing silver at $1.29+ an ounce, the coinage value. The situation was resolved in an act requiring the Treasury to buy silver domestically mined after July 1, 1946, at 90.5 cents an ounce and permitting

the Secretary of the Treasury to sell silver for the domestic arts and industries at not less than 90.5 cents an ounce. With approval of the act, July 31, 1946, the situation immediately rearranged itself. The OPA raised its ceiling to 90.5 cents, and consumers were able to satisfy all needs from domestic silver mined before July 1 and from imported silver. Only 4,889 fine ounces were purchased from the Treasury under the act during 1946.

Widespread prosperity and a high marriage rate sustained the demand for sterling and plated silverware, jewelry, watch cases, church articles, pens, pencils, and other items largely in the luxury class. Consumption was large in photography, particularly for motion pictures. The industrial uses of silver had grown greatly during the war and continued to absorb much silver in 1946.

MONETARY STOCKS

Gold holdings of the United States rose $464,000,000 (2 percent) from $20,065,000,000 on January 1, 1946, to $20,529,000,000 on January 1, 1947, according to the Federal Reserve Bulletin. Total world reserves are not positively known, inasmuch as data are not available from some countries, including the United Kingdom, Germany, Italy, Japan, Australia, and U. S. S. R. Currency stabilization funds secretly held add to the difficulties in reaching an approximation. However, the Federal Reserve System estimates the total at about $35,000,000,000, of which almost 59 percent is held by the United States.

Foreign gold reserves increased rapidly after the United States entry into the war late in 1941, largely because United States war purchases abroad so greatly exceeded commercial exports in value. During the war period foreign reserves increased nearly $5,000,000,000, and United States reserves decreased over $2,500,000,000. Sharing prominently in the increase were Switzerland, Sweden, Turkey, Iran, Spain, Union of South Africa, and Latin American countries. In 1946, however, there was a reversal in the direction of the flow of gold; United States net imports for the year were one-third the world output.

United States Treasury silver holdings declined 54,662,096 fine ounces during 1946 to 1,950,520,136 ounces, principally because of large releases in the form of coin. Not included in the holdings are 410,814,344 ounces released under lend-lease agreements that provide for return of the silver.

PRICES

Since January 1934 the price of gold at the United States Mint has been $35 per fine troy ounce. The price of domestic silver mined after July 1, 1939, was fixed at $0.711+ per ounce on July 6, 1939; on July 31, 1946, the President approved an act (Public Law 579, 79th Cong.) which provided that the seigniorage to be deducted for silver mined after July 1, 1946, and delivered to the Treasury be reduced from 45 percent to 30 percent. The effect was to raise the price of domestically mined silver to 90.5 cents an ounce.

According to the Director of the Mint, the following prices for silver prevailed in London and New York (exchange-free-New York

on London, $4.030 in 1945 and $4.033 in 1946) in 1945 and 1946: London price, per ounce, 0.999 fine, January to August 1945, 25.5d. when the price became unsettled; on September 24 the London price was raised to 44.0d., which prevailed through August 5, 1946, when it was again raised to 55.5d. for the remainder of the year; New York price, per ounce, 0.999 fine, January to August 1945, 44.75 cents; September 1945 to June 1946, 70.75 cents; thereafter, because of the lapse of price control on July 1 followed by its revival July 26 and the passage of the new silver purchase act July 31, the price fluctuated widely. From July 31 until early in December the price (with one brief lapse on October 3) remained at 90⅞ cents. In December the price declined to 84 cents on December 26, where it remained for the rest of the year.

FOREIGN TRADE[1]

The excesses of exports over imports of both gold and silver in 1945 were replaced by excesses of imports over exports in 1946. The gains from imports plus the output from domestic mines greatly exceeded consumption in the arts and industries in the case of gold, and thus gold monetary stocks increased. Consumption of silver, however, was nearly twice the supply from mine output plus net imports, with the result that stocks were drawn upon.

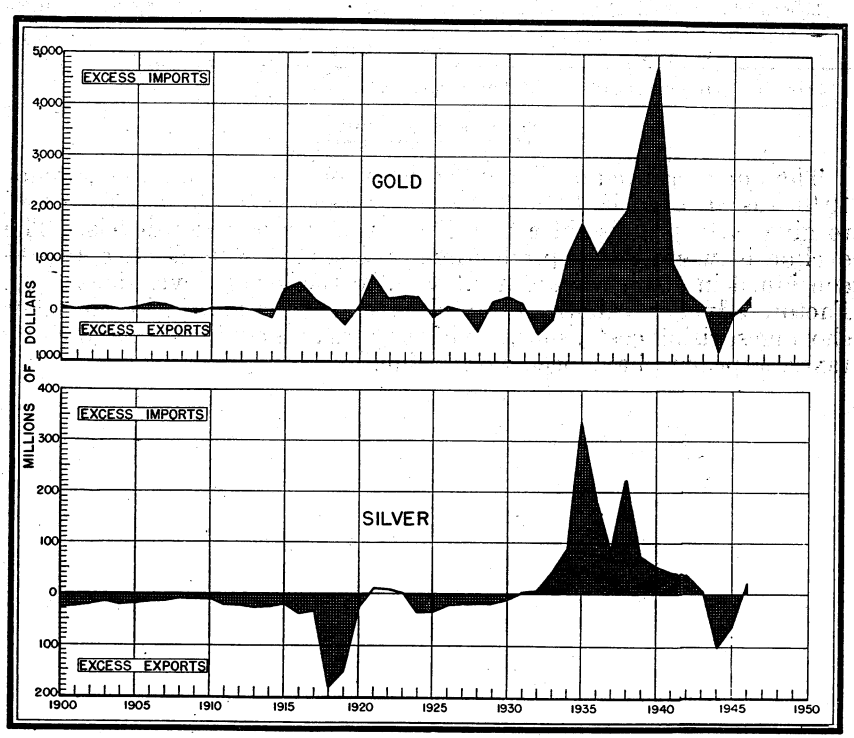

FIGURE 1.—Gold and silver imports and exports, with net movements, 1900–1946.

[1] Figures compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Value of gold and silver imported into and exported from the United States, 1945–46, by classes

	Imports	Exports	Excess of imports over exports [1]
1945			
Gold:			
Contained in ore and base bullion	$33,766,418		$33,766,418
Bullion refined	59,910,108	$198,270,054	−138,359,946
Foreign coin	41,524	1,697,886	−1,656,362
	93,718,050	199,967,940	−106,249,890
Silver:			
Contained in ore and base bullion	16,166,198		16,166,198
Bullion refined	10,106,194	70,052,904	−59,946,710
United States coin	1,003,132	2,147,506	−1,144,374
Foreign coin	2,872	18,736,491	−18,733,619
	27,278,396	90,936,901	−63,658,505
1946			
Gold:			
Contained in ore and base bullion	37,379,928	9,070	37,370,858
Bullion refined	344,707,863	221,309,154	123,398,709
United States coin	70		70
Foreign coin	150,873,907	149,412	150,724,495
	532,961,768	221,467,636	311,494,132
Silver:			
Contained in ore and base bullion	21,855,000	7,146	21,847,854
Bullion refined	28,894,402	30,098,634	−1,204,232
United States coin	890,581	1,143,000	−252,419
Foreign coin	5,937,905	5,205,910	731,995
	57,577,888	36,454,690	21,123,198

[1] Excess of exports over imports indicated by minus sign.

WORLD REVIEW

The uninterrupted decline in world output of gold in progress since 1940 was arrested in 1946, but the increase over 1945 was too small to give early promise of a return to prewar production levels. The decline in world silver production—also uninterrupted since 1940—continued in 1946, when output sank to the lowest level since 1889. Factors adverse to both gold and silver production, including labor shortages, rising costs, shortage of supplies and equipment, and rising taxes, appear to have been world-wide.

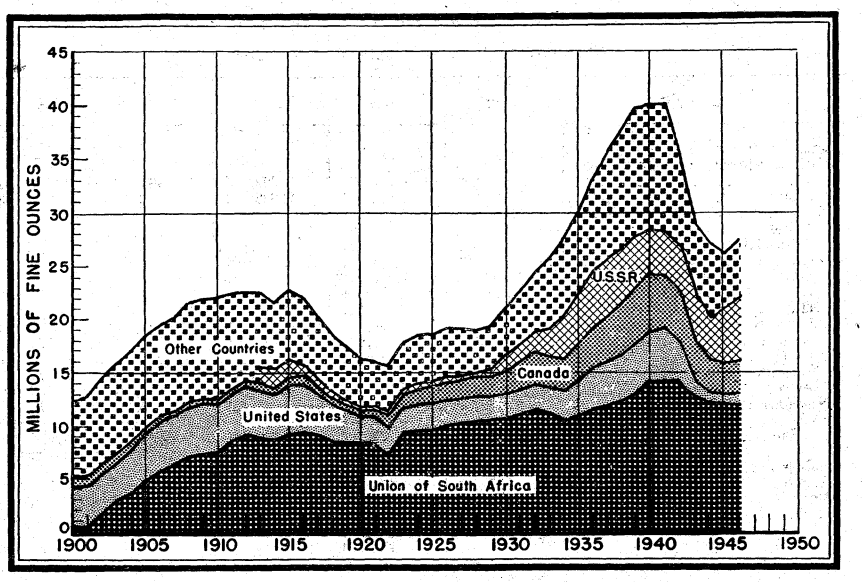

FIGURE 2.—World production of gold, 1900–46.

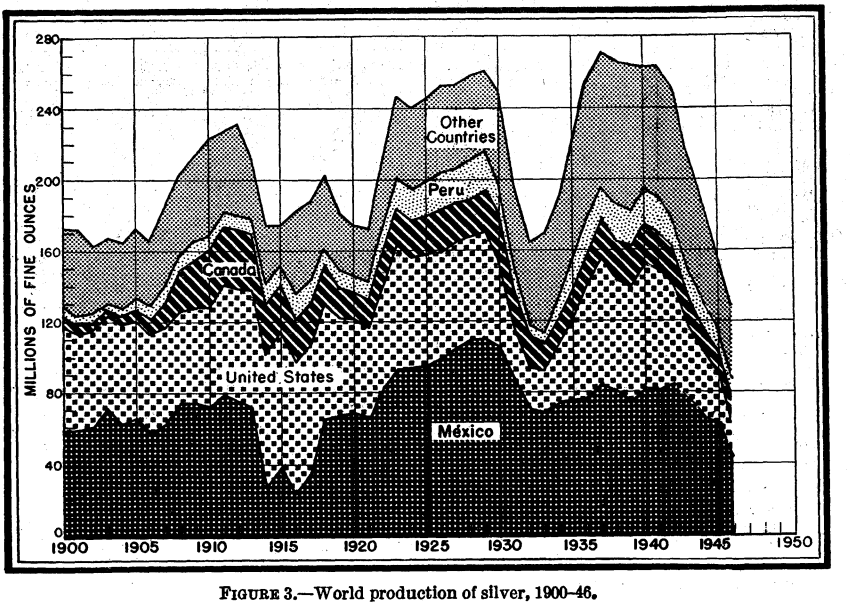

FIGURE 3.—World production of silver, 1900–46.

World production of gold, 1942–46, by countries, in fine ounces [1]

[Compiled by B. B. Mitchell and P. Roberts]

Country [1]	1942	1943	1944	1945	1946
North America:					
United States (including Alaska) [2]	3,583,080	1,380,758	1,022,238	915,403	1,462,354
Canada	4,841,306	3,651,301	2,922,911	2,696,727	2,807,643
Central America and West Indies:					
Costa Rica [3]	14,864	6,957	3,606	3,054	1,251
Cuba	[4] 195	51	39	[3] 423	1,105
Dominican Republic (exports)	6,709	816	683	486	646
Guatemala	729	409	[3] 126	[3] 66	[3] 36
Haiti	432	310	161	[3] 73	41
Honduras	29,084	20,734	19,774	17,078	12,833
Nicaragua (exports)	248,176	223,641	223,910	207,427	181,615
Panama	98				
Salvador (exports)	31,070	28,411	22,813	16,526	21,798
Mexico	801,357	631,537	508,882	499,301	420,500
Newfoundland	15,750	18,735	18,329	15,354	15,751
Total	9,572,900	5,963,700	4,743,500	4,371,900	4,925,600
South America:					
Argentina	20,994	14,467	(5)	(5)	(5)
Bolivia (exports)	5,905	4,304	4,561	3,180	2,853
Brazil	229,068	[6] 191,300	[6] 178,300	[6] 212,200	[6] 200,000
Chile	253,590	269,807	243,883	180,462	230,521
Colombia	596,618	565,501	553,530	506,695	437,176
Ecuador	88,871	90,691	84,234	66,975	77,931
Guiana:					
British	29,267	19,470	18,986	22,533	19,793
French	27,200	20,609	18,583	20,631	19,749
Netherlands (Surinam)	7,883	5,795	5,723	5,895	4,648
Peru	257,610	199,637	175,180	172,661	158,378
Venezuela	88,150	62,802	59,064	58,397	36,904
Total	1,605,200	1,444,400	[6] 1,354,000	[6] 1,259,300	[6] 1,202,000
Europe:					
Austria	868	2,315	3,109	(5)	(5)
Finland	2,218	7,137	5,048	5,884	(5)
France	44,336	34,112	21,959	25,078	34,208
Germany	5,742	(5)	(5)	(5)	(5)
Hungary [7]	61,350	61,350	28,215	193	(5)
Italy	13,310	[6] 11,600	(5)	1,603	(5)
Rumania	83,817	82,370	71,342	91,308	(5)
Spain	(5)	(5)	(5)	[6] 3,200	(5)
Sweden	175,029	156,606	112,560	85,585	(5)
U. S. S. R. [8]	4,000,000	4,000,000	4,000,000	5,000,000	6,000,000
Total	[6] 4,500,000	[6] 4,450,000	[6] 4,400,000	[6] 5,400,000	[6] 6,450,000
Asia:					
British Malaya	1,024	2,213	1,212	287	445
China	355,536	(5)	(5)	(5)	(5)
Cyprus	9,957	5,480	958		
Formosa	98,870	52,364	25,917	592	(5)
India	260,386	252,353	188,206	168,406	131,680
Indochina, French [9]	354	64	13	(5)	(5)
Japan	[10] 736,734	[10] 368,608	[10] 178,533	(5)	36,000
Korea	759,584	490,009	656,678	9,581	(5)
Netherlands Indies	58,000	(5)	(5)	(5)	(5)
Philippines, Republic of	[11] 158,726	[11] 13,764		[11] 13,490	360
Saudi Arabia	31,352	42,643	[4] 8,683	[4] 37,972	48,000
U. S. S. R.	(8)	(8)	(8)	(8)	(8)
Total	2,471,000	[6] 1,433,000	[6] 1,265,000	[6] 485,000	[6] 522,000

See footnotes at end of table.

World production of gold, 1942–46, by countries, in fine ounces [1]—Continued

Country [1]	1942	1943	1944	1945	1946
Africa:					
Bechuanaland	15,441	12,966	11,575	11,297	9,739
Belgian Congo [12]	499,944	438,858	364,204	347,453	331,304
Cameroons, French	20,747	19,625	18,378	14,667	10,735
Egypt	1,768	890	1,036	2,014	2,793
Eritrea	5	83	169	[6] 322	3,411
Ethiopia	[6] 48,000	[6] 48,000	[6] 48,000	[6] 50,000	[4] 42,032
French Equatorial Africa	83,856	80,296	74,104	69,400	65,100
French West Africa	7,202	7,973	8,777	5,388	2,370
Gold Coast (exports)	786,069	630,960	534,487	475,407	587,000
Kenya Colony	56,771	45,118	42,259	38,517	29,892
Liberia	20,700	28,800	18,000	[4] 8,100	27,000
Madagascar	8,887	9,183	9,385	6,433	([5])
Morocco, French	32	2,476	2,572	([5])	([5])
Nigeria	[4] 42,410	[4] 19,928	7,916	8,108	4,881
Portuguese East Africa	6,533	6,481	7,577	7,897	5,766
Portuguese West Africa	4,144	2,000	1,296	822	547
Rhodesia:					
Northern	1,134	703	307	253	[13] 6,838
Southern	760,030	656,684	592,729	568,241	544,596
Sierra Leone	[4] 13,174	[4] 3,613	[4] 1,493	([5])	([5])
South-West Africa	231	169	106	91	73
Sudan	5,196	2,127	1,820	1,623	3,670
Swaziland	1,129	2,734	2,299	3,583	4,914
Tanganyika (exports)	106,834	72,764	54,868	50,568	48,300
Uganda	[4] 9,468	[4] 3,820	[4] 2,593	[4] 2,295	2,420
Union of South Africa	14,126,852	12,804,379	12,279,629	12,224,629	[14] 11,917,914
Total	[6] 16,626,600	[6] 14,900,600	[6] 14,085,600	[6] 13,901,000	[6] 13,661,000
Oceania:					
Australia:					
Commonwealth [15]	1,153,787	751,279	656,867	657,212	824,480
New Guinea	[16] 102,691				
Fiji	90,973	64,420	40,443	94,964	[6] 73,000
New Zealand	165,987	149,150	142,287	128,364	119,271
Total	1,513,400	964,900	839,600	880,500	[6] 1,016,800
World total [1] [6]	36,289,000	29,157,000	26,688,000	26,298,000	27,777,000

[1] Table prepared in cooperation with the office of the Director of the Mint. Figures used derived in part from American Bureau of Metal Statistics. For some countries accurate figures are not possible to obtain owing to clandestine trade in gold. Data not available for the following countries: Bulgaria, Burma, Czechoslovakia, Norway, Papua, Portugal, Sarawak, Siam, Switzerland, United Kingdom, and Yugoslavia, but estimates included in the total.

[2] Refinery production. Excludes Republic of the Philippines.

[3] Imports into United States.

[4] Exports.

[5] Data not available; estimate included in total.

[6] Estimate.

[7] Includes Northern Territories, Sub-Carpathia, Eastern Hungary, Transylvania, and (beginning in 1942) Southern Territories.

[8] Output from U. S. S. R. in Asia included under U. S. S. R. in Europe.

[9] Lode only.

[10] Preliminary data for fiscal year ended March 31 of year following that stated.

[11] Figure published by Director of the Mint, representing gold of Philippine origin refined but not necessarily mined during the year.

[12] Includes Ruanda and Urundi.

[13] Nkana mine refinery slimes accumulated during the war yielded 6,594 ounces.

[14] Exclusive of nonmembers of the Transvaal Chamber of Mines.

[15] Includes New South Wales, Northern Territory, Queensland, South Australia, Tasmania, Victoria and Western Australia.

[16] Fiscal year ended May 31 of year stated.

World production of silver, 1942–46, by countries, in fine ounces [1]

[Compiled by B. B. Mitchell and P. Roberts]

Country [1]	1942	1943	1944	1945	1946
North America:					
United States [2]	55,859,658	40,874,050	35,651,049	29,046,047	21,103,269
Canada	20,695,101	17,344,569	13,627,109	12,942,906	12,676,928
Central America and West Indies:					
Costa Rica [3]	6,119	1,154	3,506	1,380	604
Cuba	[3] 36,238	[3] 142,420	[3] 42,985	[3] 107,195	127,222
Honduras	3,478,831	3,161,901	3,115,352	3,003,495	2,682,910
Nicaragua (exports)	265,179	251,901	248,529	234,379	223,308
Salvador (exports)	191,184	202,064	305,922	223,705	313,180
Mexico	84,864,616	76,633,062	65,460,073	61,097,727	43,263,132
Newfoundland	1,106,121	1,258,708	1,163,206	1,076,129	1,107,827
Total	166,503,000	139,870,000	119,618,000	107,733,000	81,498,000
South America:					
Argentina	2,844,344	(4)	(4)	(4)	(4)
Bolivia (exports)	8,121,438	7,299,730	6,797,631	6,683,561	6,106,165
Brazil	25,733	30,048	28,722	28,385	[5] 26,700
Chile	1,317,058	1,093,543	1,094,894	1,033,539	532,738
Colombia	246,281	209,950	197,323	168,699	152,651
Ecuador	260,771	362,013	441,345	235,500	192,200
Peru	16,035,022	14,659,742	15,832,440	12,997,741	12,334,761
Total	28,851,000	[5] 26,455,000	[5] 26,592,000	[5] 22,948,000	[5] 21,345,000
Europe:					
Austria	3,119	11,028	13,960	(4)	(4)
Czechoslovakia [6]	740,000	740,000	675,000	(4)	(4)
Finland	22,570	59,093	41,185	(4)	(4)
France	364,429	310,737	240,134	(4)	304,853
Germany	5,639,300	(4)	(4)	(4)	(4)
Hungary	805,215	1,124,311	614,300	3,200	(4)
Italy	541,740	[5] 321,500	[5] 64,300	[5] 32,200	(4)
Norway	253,991	231,485	170,399	131,818	(4)
Portugal	(4)	(4)	(4)		
Rumania	89,604	78,994	71,310	189,610	(4)
Spain	143,714	656,422	778,016	497,661	698,636
Sweden	1,476,426	1,306,220	1,292,299	1,135,178	(4)
United Kingdom	47,082	33,885	33,742	26,808	23,285
Total	(4)	(4)	(4)	(4)	(4)
Asia:					
Burma	1,225,000	(4)	(4)	(4)	(4)
China	[6] 39,018	(4)	(4)	(4)	(4)
Cyprus	38,851	17,282	4,882		
Formosa	256,476	224,367	127,873	3,156	(4)
India	20,098	18,611	14,239	14,154	(4)
Indochina, French	32		(4)	(4)	(4)
Japan	13,012,306	6,376,553	5,029,341	[7] 853,377	1,068,665
Korea	3,088,947	2,829,265	2,577,525	(4)	[8] 27,553
Netherlands Indies				(4)	(4)
Philippines, Republic of	231,197	26,071		17,208	3,600
Saudi Arabia	41,973	47,008	[9] 7,290	[9] 28,255	29,475
Total	(4)	(4)	(4)	(4)	(4)
Africa:					
Algeria	17,876	15,432	48,612	(4)	(4)
Bechuanaland	1,267	1,221	1,319	1,237	1,701
Belgian Congo	3,768,067	3,105,762	2,609,033	4,141,016	5,047,666
Gold Coast (exports)	66,580	50,288	56,820	36,666	54,525
Kenya	15,602	16,354	11,500	11,659	5,493
Morocco, French	84,556	85,714	65,427	(4)	(4)
Nigeria	(4)	(4)	1,079	(4)	(4)
Portuguese East Africa	907	559	844	998	805
Rhodesia:					
Northern	104	41			[10] 634,392
Southern	163,776	119,322	103,776	95,975	95,168
Tanganyika (exports)	25,088	18,304	17,120	21,377	21,096
Tunisia	51,023	8,906	35,205	(4)	(4)
Uganda (exports)	1,127	468	306	275	(4)
Union of South Africa	1,477,557	1,334,042	1,213,051	1,243,426	1,203,978
Total	[5] 5,675,000	[5] 4,757,000	4,164,000	(4)	(4)

See footnotes at end of table.

World production of silver, 1942–46, by countries, in fine ounces [1]—Continued

Country [1]	1942	1943	1944	1945	1946
Oceania:					
Australia:					
Commonwealth [11]	14,241,811	10,329,830	9,365,726	8,076,740	9,073,481
New Guinea	[12] 46,284				
Fiji	28,911	19,518	9,619	29,398	[5] 21,000
New Zealand	311,360	280,786	328,281	244,544	224,341
Total	14,628,000	10,630,000	9,704,000	8,351,000	9,319,000
World total [1 5]	250,000,000	217,100,000	186,200,000	157,300,000	129,000,000

[1] Silver is also produced in British Malaya, Bulgaria, Greece, Hong Kong, Poland, Sarawak, Sierra Leone, South-West Africa, Turkey, U. S. S. R., and Yugoslavia; production data are not available, but estimates are included in totals for 1942–44.
[2] Excludes Republic of the Philippines.
[3] Imports into the United States. Scrap is included in this figure in many instances, most notably in the case of Cuba.
[4] Data not available; estimate included in total.
[5] Estimate.
[6] Data represent areas designated as Free China during the period of Japanese occupation.
[7] Preliminary data for fiscal year ended March 31 of year following that stated.
[8] South Korea only.
[9] Exports.
[10] Recovered from Nkana mine refinery slimes accumulated during the war.
[11] Includes New South Wales, Northern Territory, Queensland, South Australia, Tasmania, Victoria and Western Australia.
[12] Fiscal year ended May 31 of year stated.

CANADA

After an uninterrupted decline since 1941, Canadian gold production increased slightly in 1946 compared with 1945. Silver output, however, which had decreased annually since 1940, continued its downward trend, reaching 12,676,928 fine ounces in 1946. Silver production was the lowest since 1906. Output of gold in 1945 and 1946, distributed by Provinces, was as follows:

Province or Territory:	*1945 (fine ounces)*	*1946 (fine ounces)*
Alberta	7	105
British Columbia	186,854	123,348
Manitoba	70,655	78,732
Northwest Territories	8,655	19,738
Nova Scotia	3,291	4,579
Ontario	1,625,368	1,835,887
Quebec	661,608	586,231
Saskatchewan	108,568	112,000
Yukon	31,721	47,023
Total	2,696,727	2,807,643

MEXICO AND CENTRAL AMERICA

Mexico.—Mexico's long record as the world's leading silver producer continued in 1946, despite an uninterrupted decline in output since 1942 due largely to unstable labor conditions and a serious deterioration of rail facilities. Gold output in Mexico experienced a decline paralleling that for silver.

Honduras.—Honduras, the leading silver producer in Central America, derived most of its output in 1946 from the Rosario group near Tegucigalpa. Total production of both gold and silver declined in 1946 compared with 1945.

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Nicaragua.—Nicaragua continued to be the leading gold producer in Central America despite a substantial decline in output in 1946 compared with 1945.

SOUTH AMERICA

Brazil.—Gold output in Brazil in 1946, as for many preceding years, was centered in Minas Gerais, where the St. John d'El Rey Mining Co. was by far the most important producer.

Colombia.[2]—Higher operating costs and difficulties in obtaining machinery, particularly dredging equipment for the gold-platinum placers, have proved adverse factors in the Colombian gold industry, with the result that the decline in gold production begun in 1942 continued in 1946.

Peru.—Peru continued to produce over half the silver in South America. The local silversmithing industry based on Inca designs has expanded rapidly since 1941. Wrought silver was exported to Venezuela, the United States, Panama, the Canal Zone, Brazil, and many other countries.

AFRICA

Union of South Africa.—The level of gold output was nearly sustained in the Union of South Africa in 1946. Rising costs at Rand mines reduced profits and caused the suspension of some operations. The following data prepared by the Transvaal Chamber of Mines compare mining results in 1944, 1945, and 1946:

	1944	*1945*	*1946*
Ore milled (tons)	58, 504, 400	58, 897, 600	56, 927, 500
Gold recovered (fine ounces)	12, 277, 228	12, 213, 545	11, 917, 914
Gold recovered (dwt. per ton)	4. 039	3. 997	4. 024
Working revenue	£99, 623, 168	£101, 847, 382	£99, 249, 814
Working revenue per ton	34s 1d	34s 7d	34s 10d
Working cost	£66, 681, 942	£69, 941, 061	£72, 920, 881
Working cost per ton	22s 10d	23s 9d	25s 7d
Working cost per ounce	112s 11d	118s 10d	127s 4d
Working profit	£32, 941, 226	£31, 906, 321	£26, 328, 933
Working profit per ton	11s 3d	10s 10d	9s 3d
Dividends	£13, 617, 895	£13, 056, 263	£13, 406, 349

The figures for total gold recovered include 463,499 ounces in 1944, 443,641 ounces in 1945, and 455,634 ounces in 1946 from miscellaneous producers not embodied in other data. The dividend figures include intercompany payments; the net dividends were £13,058,422 in 1944, £12,505,386 in 1945, and £12,811,101 in 1946.

Labor difficulties were reported during 1946; several strikes occurred but none was extensive and prolonged. Increasing concern was expressed by local leaders in the industry about the future labor conditions both for white and colored workers. Against the discouraging outlook for labor and the exhaustion of old mines were the developments in the Far West Rand and the very rich diamond-drill core from a hole drilled near Odendaalsrust, 150 miles southwest of Johannesburg.

[2] Cathcart, James K. Résumé of Gold Mining in Colombia: Bureau of Mines Mineral Trade Notes, Special Suppl. 11, Dec. 20, 1946, 19 pp.

South of the Witwatersrand outcrops which pass through Johannesburg in an east-west direction and across the Vaal River in the Orange Free State is a large area where the older rocks, including the gold-bearing conglomerates of the Witwatersrand system, are covered unconformably by the younger flat-lying Karoo system. Before the outbreak of war in 1939 geophysical surveys had been carried on to determine where the Karoo cover was thin and where the underlying rocks showed the low density characteristic of the Witwatersrand system. A number of holes had been drilled, and gold-bearing conglomerate beds had been encountered.[3] With the end of hostilities, exploration was resumed, and in April 1946 an extremely rich strike was made. It was announced in the following official statement issued by the Anglo American Corp. on behalf of the Western Holdings and Blinkpoort Cos.:

> About five miles south-east of Odendaalsrust, Geduld Hole No. 1, situated on the boundary between Geduld No. 697 and Friedesheim No. 511, which is being drilled for joint account by Blinkpoort Gold Syndicate and Western Holdings, has intersected the Basal Reef at a depth of 3,922 ft., with a true width of 18.4 in. assaying 1,252 dwt. per ton, which is equivalent to 23,037 in.-dwt. Above this intersection, at a depth of 3,853 ft. 6 in., an upper reef was encountered which assayed 5.14 dwt. over 28 in., equivalent to 144 in.-dwt. In view of the special importance of this basal reef intersection the Boards of the two interested companies have decided to publish this result immediately.

A huge stock-market boom resulted from the latter developments. The Orange Free State drilling and development work, however, had not advanced by the end of 1946 to a point where substantial tonnages of ore are blocked out.

ASIA

Burma.—Reports from the Bawdwin mine, the leading silver producer of Asia in prewar years, indicated that substantial output would require several years for reestablishing transportation facilities, recruiting a labor force, and rehabilitating the mine and surface plant.

OCEANIA

Australia.—The decline in gold output of the Commonwealth of Australia in progress during the war was arrested in 1945, and in 1946 a substantial increase took place. High costs and labor shortages impeded the revival, however. Although gold-production data for New Guinea are not available, this area promises soon to regain its prominence as a source of gold.

[3] Frost, A., McIntyre, R. C., Papenfus, E. B., and Weiss, O., The Discovery and Prospecting of a Potential Gold Field Near Odendaalsrust in the Orange Free State, Union of South Africa: Jour. Chem. Met. and Min. Soc., South Africa, vol. 47, No. 3, September 1946, pp. 107–141.

Gypsum

By CHARLES L. HARNESS AND M. G. DOWNEY

GENERAL SUMMARY

TO SERVE reviving construction demands, the gypsum industry in the United States produced and imported 7,086,538 short tons of gypsum in 1946, a new record. Mine output reached 5,629,398 tons, nearly equal to the production record of 5,678,302 tons established in 1925. Imports were 1,457,140 tons. The total supply was 10 percent above the previous record set in 1926 and 64 percent above 1945.

Salient statistics of the gypsum industry in the United States, 1942–46

	1942	1943	1944	1945	1946
Active establishments [1]	90	85	77	75	80
Crude gypsum [2]—					
Mined short tons	4,697,568	3,877,541	3,761,234	3,811,723	5,629,398
Imported do	394,460	231,323	342,462	508,762	1,457,140
Apparent supply do	5,092,028	4,108,864	4,103,696	4,320,485	7,086,538
Calcined gypsum produced: [3]					
Short tons	3,045,082	2,557,730	2,363,143	2,485,090	4,169,662
Value	$16,403,068	$14,751,587	$13,841,399	$14,473,566	$29,272,960
Gypsum products sold: [3]					
Uncalcined uses:					
Short tons	1,514,913	1,233,727	1,056,276	1,147,797	1,641,279
Value	$3,533,607	$3,114,789	$2,953,564	$3,432,727	$5,105,789
Industrial uses:					
Short tons	142,705	163,500	200,473	157,796	207,178
Value	$1,840,927	$2,258,981	$2,550,649	$2,326,363	$3,160,988
Building uses:					
Value	$57,796,210	$53,722,762	$50,196,006	$54,389,504	$88,927,786
Total value	$63,170,744	$59,096,532	$55,700,219	$60,148,594	$97,194,563
Gypsum and gypsum products—					
Imported for consumption	$508,321	$304,154	$394,603	$548,697	$1,833,088
Exported	$977,863	$283,720	$489,980	$1,502,668	$1,065,248

[1] Each mine, plant, or combination mine and plant is counted as 1 establishment.
[2] Excludes byproduct gypsum.
[3] Made from domestic, imported, and byproduct crude gypsum.

The building industry was profoundly influenced by the Veterans Emergency Housing Act, Public Law 388 of the 79th Congress, passed May 22, 1946. Under this law the Housing Expediter was empowered to control the various types of construction, with preferential treatment for veterans of World War II. Wilson Wyatt, Administrator of the National Housing Agency and the first Housing Expediter, planned to allocate materials for 1,200,000 residential "starts" in 1946, comprising 700,000 conventional houses, 250,000

temporary units, and 250,000 permanent prefabricated houses. This was to be followed by 900,000 conventional houses and 600,000 prefabricated houses in 1947. Despite discouraging shortages of labor and of nearly all types of the common building materials, 1,003,600 starts were actually made in 1946. Government construction agencies had estimated that total requirements of gypsum board and lath, including that for residential use, would be 3,431 million square feet during the year. Output was only 8 percent lower.

Price problems affected the gypsum industry in various ways in 1946. In the early part of the year there was a severe shortage of plaster retarder, which is made from hair, hoofs, and other slaughterhouse waste, but after meat was decontrolled, the retarder situation gradually eased. The prewar sales ratio of lath to board was about 2:1. However, during the past few years the proportion has been reversed, principally owing to two factors: First, under ceiling prices wallboard is said to have been a better profit item for the manufacturers, and second, the contractor can erect a house faster and cheaper with "dry-wall" construction, using board, than with "wet-wall" construction, using lath and plaster. Consequently, new residential construction now uses a great deal more wallboard than in former years. Plasterers, however, point out that a plastered wall is more permanent and has a more pleasing appearance, and it is expected that the prewar lath:board ratio eventually will reassert itself. Sheathing output also was very low because of low profit margins. Similarly, a shortage of "merchant liner" paper for making gypsum board and lath was relieved after the Housing Expediter, under authority of the Veterans Emergency Housing Act, offered premiums to manufacturers of liner paper to encourage production of this commodity (Premium Regulation 3, June 1, 1946).

Contractors holding HH priority ratings (veterans' residential projects) complained during the summer of 1946 that they were unable to obtain gypsum board. On September 1, 1946, the Civilian Production Administration ordered distributors to set aside 85 percent of their board receipts for the veterans' housing program, and during the remainder of 1946 the board supply for this use was reported much easier.

Gypsum cement retarder became rather tight in the summer of 1946, but later in the year the shortage was relieved.

DOMESTIC PRODUCTION

CRUDE PRODUCTION

Every major producing State showed an increase in 1946 as compared with the preceding year. The rising availability of labor and materials, coupled with a pent-up demand of many years standing, combined to stimulate output almost to the record level of 1925.

Active operations totaled 52, including 21 underground mines, 23 open quarries, and 8 mine-quarry combinations.

CALCINED PRODUCTION

The calcined production in 1946 was obtained from 50 active plants distributed through 23 States. Active calcining equipment in

these plants comprised 195 units, as compared with 176 in 1945. The average mill value of calcined gypsum, as reported by producers, was $7.02 per short ton, an increase of $1.20 over the 1945 value.

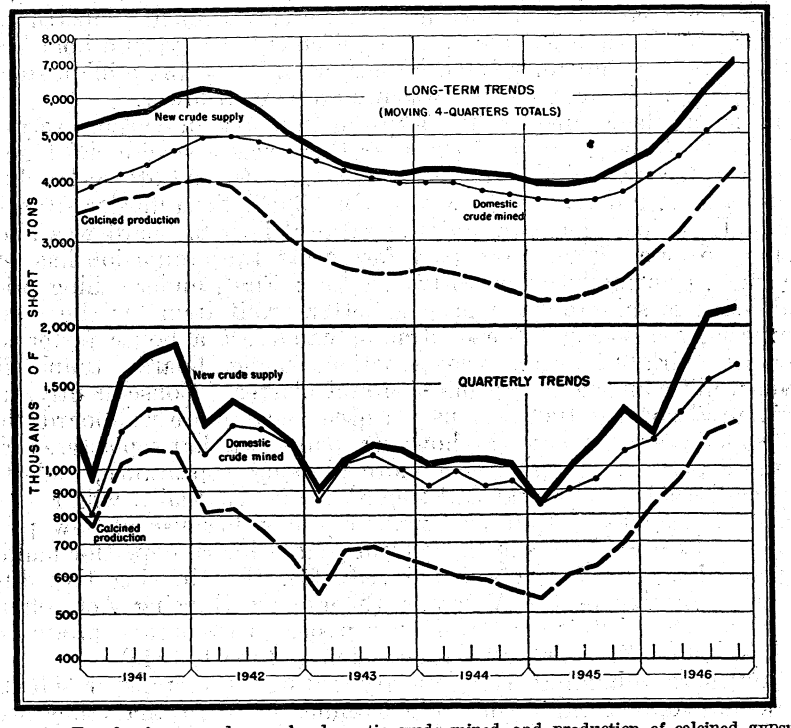

FIGURE 1.—Trends of new crude supply, domestic crude mined, and production of calcined gypsum, 1941–46, by quarters.

Crude gypsum mined in the United States, 1944–46, by States

State	1944			1945			1946		
	Active mines	Short tons	Value	Active mines	Short tons	Value	Active mines	Short tons	Value
Arizona				1			2		
Arkansas	1	107,179	$133,306	1	120,422	$160,156	1	212,231	$456,361
Kansas	2			2			2		
California	6	502,629	799,882	5	455,319	967,507	6	574,345	1,315,699
Colorado	2			3			3		
Montana	2	137,773	254,894	2	129,587	243,214	2	199,895	474,704
South Dakota	1			1			1		
Wyoming	1			1			2		
Iowa	5	398,143	655,392	5	430,843	569,964	5	560,094	1,172,500
Michigan	4	552,672	891,965	4	640,186	862,028	4	1,120,070	2,171,979
Nevada	3	392,748	693,107	3	368,246	732,253	3	490,253	1,164,083
New York	7	594,067	1,128,821	7	557,902	1,262,989	7	814,999	1,961,157
Ohio	2	515,075	1,023,140	2	477,595	1,356,592	2	584,755	1,482,269
Virginia	2			2			2		
Oklahoma	2	216,012	380,622	2	223,983	317,752	2	301,123	612,148
Utah	2			2			2		
Texas	7	344,936	489,638	6	407,640	511,869	6	771,633	1,630,929
	49	3,761,234	6,450,767	49	3,811,723	6,984,324	52	5,629,398	12,441,829

Calcined gypsum produced in the United States, 1945–46, by districts [1]

District	1945		1946	
	Short tons	Value	Short tons	Value
New Hampshire, Massachusetts, and Connecticut	50,102	$394,764	155,268	$1,228,340
Eastern New York, New Jersey, Pennsylvania, Georgia, and Florida	204,075	1,551,450	623,875	4,862,620
Western New York	394,994	1,951,849	545,686	3,735,566
Ohio and Virginia	309,500	1,961,566	379,531	2,858,570
Michigan and Indiana	374,647	2,222,934	639,764	4,554,987
Iowa	286,422	1,467,605	443,966	3,066,319
Kansas and Oklahoma	178,736	1,164,396	216,003	1,654,360
Texas	273,102	1,288,755	518,587	3,291,439
Colorado, Wyoming, South Dakota, Montana, and Utah	96,158	707,092	150,638	1,086,582
California and Nevada	317,354	1,763,155	496,344	2,934,177
	2,485,090	14,473,566	4,169,662	29,272,960

[1] Made from domestic, imported, and byproduct crude gypsum.

Active calcining plants and equipment in the United States, 1944–46, by States

State	1944			1945			1946		
	Calcining plants	Equipment		Calcining plants	Equipment		Calcining plants	Equipment	
		Kettles	Other calciners [1]		Kettles	Other calciners [1]		Kettles	Other calciners [1]
California	4	7	6	3	7	4	4	10	4
Iowa	5	17	4	5	15	4	5	17	4
Michigan	4	20		4	19		4	19	
New York	7	22	6	7	20	6	7	20	6
Texas	4	24		4	27		5	28	
Other States [2]	23	61	23	21	54	20	25	64	23
	47	151	39	44	142	34	50	158	37

[1] Includes rotary and beehive kilns, grinding-calcining units, and hydrocal cylinders.
[2] Calcining plants in 1944–46: 1 each in Connecticut, Indiana, Massachusetts, Oklahoma, and South Dakota; 2 each in Colorado, Kansas, Montana, Nevada, Ohio, Utah, and Virginia. In addition—1944: 1 each in Florida and Vermont, and 2 in New Jersey; 1945: 1 each in Georgia and New Jersey; 1946: 1 each in Florida, Georgia, New Hampshire, New Jersey, Pennsylvania, and Wyoming.

CONSUMPTION AND USES

Of the products sold, building materials made the largest gains. Portland-cement retarder was up 71 percent, base-coat plasters 135, and lath 91 percent. Large increases were also noted for the other plasters and boards, except sheathing and laminated board. Price difficulties inhibited sheathing sales, and demand for laminated board declined.

The market for agricultural gypsum for use on the alkaline soils of California and other West Coast States and on the peanut crops of the Southeastern States showed a slight increase.

Industrial plasters were also up. These are used in bedding plate glass for polishing, in making molds and patterns for pottery and for nonferrous castings, and in numerous miscellaneous applications in shop and factory. Dental and orthopedic plasters declined somewhat.

Figure 3 correlates sales of lath and other gypsum board with floor area of new construction. All showed increases.

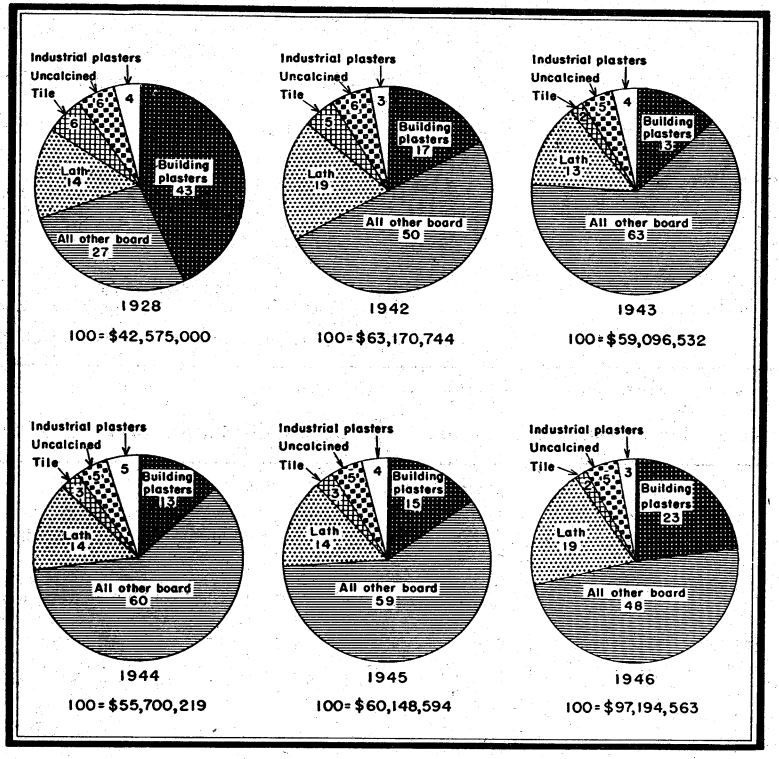

FIGURE 2.—Percentage distribution of total sales value, f. o. b. plant, of gypsum products in 1928 and 1942–46, by groups of products.

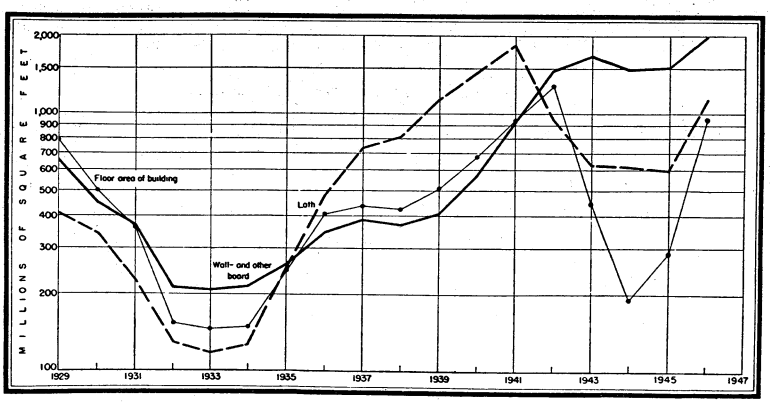

FIGURE 3.—Trends in sales of gypsum lath and wallboard and other board (includes wallboard, laminated board in terms of component board, and sheathing) compared with Dodge Corp. figures on floor area of residential and nonresidential building, 1929–46.

Gypsum products (made from domestic, imported, and byproduct crude gypsum) sold or used in the United States, 1945–46, by uses

Use	1945			1946			Percent of change in—	
	Short tons	Value		Short tons	Value			
		Total	Average		Total	Average	Tonnage	Average value
Uncalcined:								
Portland-cement retarder	664,247	$1,502,689	$2.26	1,135,853	$2,949,860	$2.60	+71	+15
Agricultural gypsum	462,217	1,715,982	3.71	471,902	1,855,515	3.93	+2	+6
Other uses [1]	21,333	214,056	10.03	33,524	300,414	8.96	+57	−11
Total uncalcined uses	1,147,797	3,432,727		1,641,279	5,105,789		+43	
Industrial:								
Plate-glass and terra-cotta plasters	20,317	136,378	6.71	36,654	284,716	7.77	+80	+16
Pottery plasters	30,807	414,187	13.44	44,808	627,913	14.01	+45	+4
Orthopedic and dental plasters	13,907	416,712	29.96	13,322	439,471	32.99	−4	+10
Other industrial uses [2]	92,765	1,359,086	14.65	112,394	1,808,888	16.09	+21	+10
Total industrial uses	157,796	2,326,363		207,178	3,160,988		+31	
Building:								
Cementitious:								
Plasters:								
Base-coat	640,276	6,103,402	9.53	1,507,115	16,088,863	10.68	+135	+12
Sanded	68,485	428,631	6.26	113,983	864,579	7.59	+66	+21
To mixing plants	10,938	70,827	6.48	15,553	121,857	7.83	+42	+21
Gaging and molding	88,800	1,084,902	12.22	165,061	2,230,931	13.52	+86	+11
Prepared finishes	6,663	213,211	32.00	11,753	445,864	37.94	+76	+19
Insulating and roof-deck	35,300	286,302	8.11	70,956	623,844	8.79	+101	+8
Other [3]	14,918	681,930	45.71	21,326	1,190,576	55.83	+43	+22
Keene's cement	14,158	217,723	15.38	32,476	482,717	14.86	+129	−3
Total cementitious	879,538	9,086,928		1,938,223	22,049,231		+120	
Prefabricated:								
Lath	445,497	8,177,308	[4] 13.64	865,682	18,550,334	[4] 16.17	[5] +91	[4] +19
Wallboard	1,023,537	28,994,151	[4] 22.53	1,517,035	43,699,483	[4] 22.99	[5] +48	[4] +2
Sheathing board	102,692	2,304,165	[4] 22.90	79,673	2,021,691	[4] 26.29	[5] −24	[4] +15
Laminated board	125,222	4,002,216	[4] 34.23	22,837	792,560	[4] 37.18	[5] −82	[4] +9
Tile	104,943	1,824,736	[6] 42.62	108,721	1,814,487	[6] 47.92	[5] +5	[6] +12
Total prefabricated	1,801,891	45,302,576		2,593,948	66,878,555		+44	
Total building uses		54,389,504			88,927,786			
Grand total value		60,148,594			97,194,563			

[1] Includes uncalcined gypsum sold for use as filler and rock dust, in brewer's fixe, color manufacture, and for unspecified uses.
[2] Includes statuary, industrial casting and molding plasters, dead-burned filler, granite polishing, and miscellaneous uses.
[3] Includes joint filler, patching and painter's plaster, and unclassified building plasters.
[4] Average value per M square feet.
[5] Percent of change in square footage.
[6] Average value per M square feet of partition tile only.

Gypsum board and tile sold or used in the United States, 1942–46, by types

Year	Lath			Wallboard		
	M square feet	Value		M square feet	Value	
		Total	Average [1]		Total	Average [1]
1942	959,307	$12,116,144	$12.63	1,046,025	$23,200,410	$22.18
1943	630,639	7,863,506	12.47	1,241,828	27,296,293	21.98
1944	625,553	7,908,857	12.64	1,208,158	26,507,684	21.94
1945	599,431	8,177,308	13.64	1,286,912	28,994,151	22.53
1946	1,147,353	18,550,334	16.17	1,900,779	43,699,483	22.99

Year	Sheathing			Laminated board			Tile [2]		
	M square feet	Value		M square feet	Value		M square feet	Value	
		Total	Average [1]		Total	Average [1]		Total	Average [3]
1942	369,313	$7,016,015	$19.00	[4] 53,170	$1,464,090	$27.54	24,664	$2,915,884	$45.81
1943	231,356	4,683,376	20.24	[4] 200,815	5,450,818	27.14	11,639	1,112,654	42.78
1944	114,704	2,300,069	20.05	[4] 167,580	4,714,096	28.13	15,067	1,426,560	41.63
1945	100,627	2,304,165	22.90	[4] 116,908	4,002,216	34.23	17,988	1,824,736	42.62
1946	76,914	2,021,691	26.29	[4] 21,317	792,560	37.18	18,865	1,814,487	47.92

[1] Per M square feet, f. o. b. producing plant.
[2] Includes partition, roof, floor, soffit, shoe, and all other gypsum tiles and planks.
[3] Per M square feet, f. o. b. producing plant, of partition tile only.
[4] Reported as area of component board and not of finished product.

PRICES

The average value reported for crude gypsum mined was $2.21 per short ton ($1.83 in 1945). In the 1946 canvass producers were asked to estimate as closely as possible the theoretical market value of their material, even though they used it themselves. It is believed that in previous years the figures submitted have ranged from bare cost figures upward.

About three-quarters of the gypsum produced in the United States is calcined by the producer and does not enter the open market. The remainder is sold largely as portland-cement retarder and agricultural gypsum. The average value for retarder sales in 1946 was $2.60, as against $2.26 in 1945, and for agricultural sales $3.93, compared with $3.71 in 1945.

The Bureau of Labor Statistics reported that the average wholesale price of base-coat plaster, f. o. b. cars destination, was $13.74 per ton in January 1946, rising to $14.28 by December 1946. Plaster lath on a similar basis rose from $18.26 per thousand square feet in January to $19.89 in December. The cost of a square yard of installed plaster in Washington, D. C., was about $1.50 in 1946.

PLANT EXPANSIONS

The capacity of the gypsum industry to produce plaster and board has not been canvassed since 1941 (see Minerals Yearbook, 1941, pp. 1295–1297). In that year 36 board machines were reported having a capacity of 13 million square feet of ⅜-inch lath or 11 million square feet of ⅜-inch wallboard per 24-hour day, or over 4 billion square feet a year. (Needless to say, it is impossible to operate at 100 percent of capacity over any prolonged period of time.) There has been considerable variation in capacity because some plants were closed and the output of others increased, and the over-all effect seems to have been an increase to at least 4¾ billion square feet, in view of the fact that actual board output was at the annual rate of 4 billion square feet in the closing months of 1946. Capacity will be augmented further in 1947, when five new plants are placed in operation.

National Gypsum Co. is building at Baltimore, Md., a $6,000,000 plant which will have a capacity of 90 tons of plaster per hour and 120 feet of board per minute. It will calcine Canadian gypsum and make board and plasters.[1] This firm is also spending $1,000,000 to rehabilitate its calcining and board plants at Clarence Center, N. Y., where it got its start 21 years ago,[2] and $600,000 to expand its lath facilities at Niles, Ohio.[1] The Rotan, Tex., plant, to be completed in July 1947, will cost $1,000,000 and expansion of the Savannah, Ga., plant, $750,000.[1] This firm is also doubling capacity of mines and plants at Medicine Lodge, Kans.[3]

The Standard Gypsum Co., Long Beach, Calif., owned by Henry J. Kaiser & Associates, is building a board plant.

The United States Gypsum Co. was building three plants in 1946–47, at Plaster City, Calif.; Sigurd, Utah; and Berkley, Va. The Sigurd plant is 135 miles south of Salt Lake City on a 920-acre tract purchased in 1936. It will make all types of plaster and standard lath, board, and sheathing.[4] The Berkley plant, near Norfolk, will cost $670,000 and have a daily capacity of 350,000 square feet of ⅜-inch gypsum board.[5]

The full effect of these new plants and rehabilitation of old ones probably will not be felt until the latter part of 1947, or possibly not until 1948, as the bottleneck in paper liner is not expected to ease until late in 1947.

A new plaster producer, the Gulf States Gypsum Co., Houston, Tex., shipped its first car of wall plaster in November 1946. The plant is 4½ miles south of Hockley, Tex., and has two kettles with a total capacity of 200 tons of plaster daily.[6]

Among the new plants beginning production in 1946 was the plaster mill of the Union Plaster Co., at Phoenix, Ariz. Raw gypsum from the deposit at Winkleman, near Phoenix, is used.[7] The Arizona

[1] Rock Products, vol. 50, No. 3, March 1947, p. 62.
[2] Pit and Quarry, vol. 39, No. 6, December 1946, p. 56.
[3] Rock Products, vol. 50, No. 3, March 1947, p. 63.
[4] Engineering and Mining Journal, vol. 148, No. 1, January 1947, p. 120.
[5] Rock Products, vol. 49, No. 10, October 1946, p. 65.
[6] Rock Products, vol. 50, No. 1, January 1947, p. 85.
[7] Rock Products, vol. 49, No. 11, November 1946, p. 56. Pit and Quarry, vol. 39, No. 6, December 1946, p. 55.

Gypsum Corp., of Phoenix, also opened a new mine at Winkleman, Ariz.

Stripping has exposed a 25-foot thick gypsum deposit on property of the Certain-teed Products Corp., near Fort Dodge, Iowa. The deposit is believed to extend over 80 acres and to comprise 6 million tons of gypsum.[8]

TECHNOLOGIC DEVELOPMENTS

A new commercial type of gypsum plaster—alpha gypsum—heretofore isolated only in the laboratory, was described and recommended for molds and patterns.[9] The new material has low setting expansion, low water : plaster ratio, and a period of plasticity sufficient for trimming; molds made from it have dimensional stability during long storage.

Gypsum board lends itself easily to prefabricated construction, as it is resilient, nailable, and easily cut. It is reported that it is used in prefabricated steel houses.[10]

The labor shortage accentuated the trend toward mechanization of gypsum mines. Notable were the use of caterpillar-mounted loading machines with battery-operated, rubber-tired shuttle cars, and detachable steel and carboloy bits for drilling strata of varying hardness.[11]

ALABASTER

Alabaster mining was well under way again in 1946; and, according to incomplete returns, the following firms and persons offered commercial-grade alabaster in 1946: Alabaster Co. of America, Livermore, Colo.; Pioneer American Alabaster Co., Fort Collins, Colo.; J. Evan Roberts, Livermore, Colo.; and Elza Owen, La Junta, Colo.

According to a release by the Alabaster Co. of America:—

> The stone can be cut with the ordinary hand saw or hack saw. The hand saw, of course, must be sharpened often. Carborundum cutoff saws used in a power saw head are ideal for cutting small slabs for flat work * * *. Turning may be done on wood or metal lathes with either wood or metal cutting tools or any combination of them. The stone is best held in place on the lathe by a machine chuck, which may be either the three- or four-jaw type, independent or universal * * *. The articles may be dressed with emery cloth and finished with wet or dry sandpaper, and during sanding, the surface should be kept wet * * *. The stone is best polished on a buff wheel with abrasives such as those used on brass and silver.

The miners generally use care in mining alabaster. A typical method is channeling and wedging, supplemented by hydraulic lifts for breaking out sections of stone. When a new opening is started on a ledge, slow, coarse black powder may be used, and the inevitable fractured material is discarded.

From alabaster, artisans make attractive lamps, urns, vases, bowls, jars, pen stands, and numerous other useful items and novelties.

[8] Pit and Quarry, vol. 39, No. 1, July 1946, p. 73.
[9] Offutt, J. S., and Lambe, C. M., Plasters and Gypsum Cements for the Ceramic Industry: Am. Ceram. Soc. Bull., vol. 26, No. 2, Feb. 15, 1947, p. 29.
[10] Steel, vol. 119, No. 17, Oct. 21, 1946, p. 76.
[11] Cushing, E. R., Gypsum Mine Mechanization: Rock Products, vol. 49, No. 7, July 1946, pp. 68–70 and 106–110, and No. 8, August 1946, pp. 92–97.

FOREIGN TRADE [12]

Of the 1,429,057 short tons of gypsum and anhydrite imported from Canada, 695,409 tons were landed in the New York customs district, 210,457 in the Georgia district, 118,162 in the Philadelphia district, 114,843 in the Massachusetts district, and 107,356 in the Maine and New Hampshire district. The remainder was brought in through the Florida, Virginia, Connecticut, Puerto Rico, Maryland, and Buffalo districts.

Gypsum and gypsum products imported for consumption in the United States, 1942–46

Year	Crude (including anhydrite)		Ground		Calcined		Keene's cement		Alabaster manufactures [1]	Other manufactures, n. e. s.	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value			
1942	394,460	$478,144	1,048	$20,427	309	$8,205	20	$484	$227	$834	$508,321
1943	231,323	275,503	958	18,902	73	1,950	16	392	1,064	6,343	304,154
1944	342,462	382,533	376	6,965	75	2,653	4	120	318	2,014	394,603
1945	508,762	525,066	231	4,545	67	2,209			499	16,378	548,697
1946	1,457,140	1,621,666	354	7,308	255	6,918	162	3,686	119,937	73,573	1,833,088

[1] Includes imports of jet manufactures, which are believed to be negligible.

Crude gypsum (including anhydrite) imported for consumption in the United States, 1944–46, by countries

Country	1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value
Canada	339,956	$372,468	502,530	$507,212	1,429,057	$1,559,544
China					(1)	34
Dominican Republic	2,504	10,045	3,652	15,274	9,312	42,005
India and Dependencies	2	20				
Mexico					9,519	9,120
Newfoundland and Labrador			2,580	2,580	9,252	10,963
	342,462	382,533	508,762	525,066	1,457,140	1,621,666

[1] Less than 1 ton.

Gypsum and gypsum products exported from the United States, 1942–46

Year	Crude, crushed, or ground		Calcined		Plasterboard and wallboard		Other manufactures n. e. s.	Total value
	Short tons	Value	Short tons	Value	Square feet	Value		
1942	595	$14,543	1,859	$84,784	39,489,186	$772,989	$105,547	$977,863
1943	5,300	22,405	2,436	98,229	2,953,173	84,163	78,923	283,720
1944	870	18,604	5,620	166,145	7,236,665	180,021	125,210	489,980
1945	1,067	18,909	8,961	248,853	31,835,980	1,017,677	217,229	1,502,668
1946	4,071	56,524	15,555	343,795	12,405,583	417,750	247,179	1,065,248

[12] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

WORLD REVIEW

Global construction drew heavily on the gypsum industry of nearly every civilized region in 1946. Many deposits closed during the war years were reopened and new ones prospected. The United States has been the country of greatest production for some years, followed by the United Kingdom, Canada, Soviet Russia, and France, in approximately that order.

World production of gypsum, 1939–46, by countries, in metric tons [1]

[Compiled by P. Roberts]

Country [1]	1939	1940	1941	1942	1943	1944	1945	1946
Algeria	(2)	(2)	23,375	23,720	17,920	(2)	(2)	(2)
Anglo-Egyptian Sudan			748	1,558	3,641	(2)	2,106	3,063
Argentina [3]	58,190	73,854	88,076	88,688	87,461	106,300	(2)	(2)
Australia:								
New South Wales	7,145	11,010	23,458	19,564	36,862	20,540	23,137	(2)
South Australia	147,266	155,901	115,323	58,124	40,157	47,294	66,653	91,878
Victoria	11,966	7,237	16,013	9,130	9,073	8,717	11,755	15,184
Western Australia	14,570	13,229	9,666	2,924	950	3,662	7,349	15,596
Belgian Congo		500	2,533	2,937				
Brazil	(2)	[4] 45,000	(2)	(2)	(2)	(2)	(2)	(2)
Canada	1,390,183	1,397,778	1,415,600	723,137	390,833	486,571	753,615	[5] 1,663,511
Chile	22,209	25,865	23,125	28,028	32,893	33,909	(2)	(2)
China [6]	5,400	37,100	37,100	37,900	(2)	(2)	(2)	(2)
Cuba [7]	6,270	12,000	12,000	4,300	3,200	10,000	10,400	14,300
Cyprus (exports)	5,548	1,625	180	273	134	3,492	2,608	15,464
Dominican Republic (exports)			3,040		916	2,146	3,258	10,974
Egypt	700,166	169,723	130,942	118,931	91,881	106,299	96,565	78,316
Eire	16,168	21,662	24,660	16,567	21,453	21,394	23,400	(2)
France	(2)	(2)	(2)	840,030	722,217	703,412	244,000	448,950
Greece	15,219	(2)	(2)	(2)	(2)	(2)	(2)	(2)
India	69,786	79,257	53,910	64,386	83,587	85,049	92,229	(2)
Indochina				3,000	720	(2)	(2)	(2)
Iraq	69,545	34,879	(2)	(2)	(2)	(2)	(2)	(2)
Italy	433,145	454,662	328,445	(2)	(2)	(2)	(2)	(2)
Japan [8]	164,775	175,402	208,149	186,584	156,571	123,833	83,421	(2)
Kenya	(2)	(2)	(2)	(2)	40	254	159	421
New Caledonia	(2)	3,000		[7] 24,000	16,800	16,692	8,030	6,750
Palestine	4,524	4,403	4,841	8,118	5,990	7,428	7,542	(2)
Peru	15,655	21,478	22,472	19,514	20,326	25,070	37,998	49,582
Portugal	(2)	(2)	(2)	(2)	4,367	(2)		(2)
Rumania	16,747	25,031	69,590	33,650	44,044	(2)	(2)	(2)
Spain				37,567	73,291	59,889	40,569	(2)
Spanish Morocco	(2)	(2)	(2)	(2)	3,300	(2)	(2)	(2)
Sweden	102	13	(2)	(2)	740	(2)	(2)	(2)
Switzerland	38,000	30,000	35,000	38,000	42,000	46,000	97,000	68,000
Syria	(2)	(2)	1,000	5,000	2,500	(2)	(2)	1,200
Union of South Africa (sales)	40,782	46,202	48,326	50,823	47,608	57,426	62,321	(2)
U. S. S. R.: [1] Latvia	245,035	(2)	(2)	(2)	(2)	(2)	(2)	(2)
United Kingdom:								
Great Britain	1,042,760	1,032,275	1,196,900	1,231,613	1,389,914	1,344,485	1,347,888	1,715,060
Northern Ireland	(2)	288	(2)	(2)	(2)	(2)	71	(2)
United States	2,927,231	3,355,672	4,344,062	4,261,540	3,517,628	3,412,116	3,457,919	5,106,877
Total (estimate) [9]	8,031,000	7,935,000	8,958,000	8,548,000	7,400,000	7,207,000	7,070,000	10,319,000

[1] In addition to the countries listed gypsum is produced in Austria, Ethiopia, French Morocco, Germany, Luxembourg, Mexico, Poland, Tunisia, U. S. S. R. (other than Latvia), and Yugoslavia, but production data are not available.
[2] Data not available; estimate included in total.
[3] Rail and river shipments.
[4] Production of one company only.
[5] Sales.
[6] Data represent areas designated as Free China during period of Japanese occupation.
[7] Estimate.
[8] Preliminary.
[9] Excludes estimates for countries listed in footnote 1.

Canada.—Sales of raw gypsum in 1946, as reported by the Dominion Bureau of Statistics, were 1,833,717 short tons. United States imports of Canadian gypsum for consumption were 1,429,057 short tons valued at $1,559,544.

Adequate shipping was available in 1946 to carry record loads of gypsum from Nova Scotia to board and plaster plants on the Atlantic seaboard of the United States. Quarrying operations in Nova Scotia were reviewed by McFarland.[13] Gypsum, Lime & Alabastine, Canada, Ltd., of Toronto, announced plans for improving its Montreal plant.[14]

[13] McFarland, J. W., Quarrying Gypsum in Nova Scotia: Explosives Eng., vol. 25, No. 1, January-February 1947, pp. 20–21, 26.
[14] Rock Products, vol. 50, No. 1, January 1947, p. 85.

Iron Ore

By NORWOOD B. MELCHER

	PAGE		PAGE
General summary	600	Consumption	617
Salient statistics	601	Stocks	617
Production and shipments	602	Prices	618
Principal mines	608	Foreign trade	619
Sinter	609	Beneficiation	619
Review of Lake Superior district	610	Employment	620
Mining by States	614	World review	622

GENERAL SUMMARY

PRODUCTION of iron ore in 1946 dropped to about four-fifths of the 1945 level largely as a result of strikes at iron and coal mines, steel plants, and in Lake Superior shipping. The strikes affecting iron-ore production occurred at the critical time of the year, when the Lake shipping season is usually getting under way. Consequently, production in March was about one-third the March 1945 level, and during April 1946 production amounted to only 2.2 million tons, compared with 8.2 million tons during April 1945, and consumers had to rely heavily on stocks at consuming plants and lower lake ports. Fortunately, however, stocks of iron ore at consuming plants considerably exceeded those of the previous year, and at no time were furnaces obliged to shut down for lack of iron ore. On May 1, 1946, the date when iron-ore stocks are normally lowest, the available tonnage was 40 percent higher than on the same date in 1945. All producing districts reported a drop in iron-ore output during 1946, but the resulting decrease in production from the Birmingham area was much less than in others. Consequently, the Birmingham district produced 8 percent of the United States total of usable ore during 1946, compared with 7 percent in 1945; output continued virtually unchanged. Several important mines in that area continued producing when many in other areas were strikebound. The Lake Superior district accounted for 15,000,000 of the 18,000,000-ton decline during the year and produced 84 percent of the total domestic iron ore, compared with 85 percent in 1945.

Salient statistics of iron ore in the United States, 1943-46

	1943	1944	1945	1946
Crude iron ore:				
Production by districts:				
Lake Superior ... Gross tons	95,586,789	88,294,284	85,451,692	67,014,550
Southeastern ... do	14,051,854	11,469,700	9,616,593	9,278,832
Northeastern ... do	7,018,617	7,749,541	7,686,338	5,136,313
Western ... do	3,017,720	3,506,620	3,557,776	2,764,786
	119,674,980	111,020,145	106,312,399	84,194,481
Production by mining methods:				
Open pit ... do	86,849,778	82,393,899	78,935,218	63,859,082
Underground ... do	32,825,202	28,626,246	27,377,181	20,335,399
	119,674,980	111,020,145	106,312,399	84,194,481
Production by types of ore:				
Hematite ... do	104,436,944	96,238,818	92,161,239	74,127,099
Brown ore ... do	7,126,582	5,265,700	4,397,650	3,598,474
Magnetite ... do	8,110,837	9,514,555	9,752,711	6,468,184
Carbonate ... do	617	1,072	799	724
	119,674,980	111,020,145	106,312,399	84,194,481
Shipments ... do	118,622,412	112,073,286	106,538,936	83,985,686
Iron ore (usable; less than 5 percent Mn):				
Production by districts:				
Lake Superior ... Gross tons	85,789,017	79,111,320	74,821,648	59,042,154
Southeastern ... do	8,478,736	7,121,676	6,329,987	6,247,096
Northeastern ... do	3,467,575	3,849,396	3,620,147	2,596,349
Western ... do	2,859,994	3,442,405	3,087,774	2,450,611
Undistributed (byproduct ore) ... do	652,513	592,908	517,440	506,903
	101,247,835	94,117,705	88,376,393	70,843,113
Production by types of product:				
Direct ... do	79,833,785	73,260,136	67,768,993	54,014,466
Concentrates ... do	17,622,674	16,648,364	16,812,961	13,792,046
Sinter ... do	3,188,863	3,616,297	3,276,999	2,522,698
Byproduct material (pyrites cinder and sinter) ... Gross tons	652,513	592,908	517,440	506,903
	101,247,835	94,117,705	88,376,393	70,843,113
Production by types of ore:				
Hematite ... do	94,418,034	86,726,870	81,294,688	66,728,172
Brown ore ... do	1,627,490	1,218,509	942,910	686,492
Magnetite ... do	4,549,181	5,678,807	5,620,310	3,920,986
Carbonate ... do	617	611	545	650
Byproduct material (pyrites cinder and sinter) ... Gross tons	652,513	592,908	517,440	506,903
	101,247,835	94,117,705	88,376,393	70,843,113
Shipments ... do	99,462,850	95,135,675	88,136,715	70,090,410
Value	$269,016,546	$256,885,512	$243,760,986	$215,096,427
Average value per ton at mine	2.70	2.70	2.77	3.07
Stocks at mines Dec. 31 ... Gross tons	5,169,525	4,136,639	4,451,970	5,339,147
Imports ... do	399,117	463,532	1,193,514	2,754,216
Value	$1,827,053	$2,007,865	$4,100,344	$10,370,675
Exports ... Gross tons	2,424,801	2,458,447	2,062,125	1,505,854
Value	$8,117,156	$7,163,405	$6,688,156	$5,492,549
Consumption ... Gross tons	100,456,989	99,942,454	88,158,495	72,174,844
Manganiferous ore (5 to 35 percent Mn):				
Shipments ... Gross tons	1,538,275	1,327,324	1,359,692	1,045,699
Value	$4,522,052	$3,855,946	$3,513,666	$3,126,711

Iron-ore imports continued to increase during 1946, with most of the net receipts originating in Chile, Cuba, and Sweden. Canada, although supplying more iron ore to the United States than any other country, was more than compensated by receipts from the United States. The Steep Rock mine, on the Atikokan range, Ontario, now supplies most of the imports of Canadian ore for United States consumption, but much of the Canadian iron and steel industry is dependent on receipts of iron ore from the United States.

The bulk of the imported ore during 1946 was consumed in blast furnaces at Sparrows Point, Md., but important shipments were made to eastern Ohio, the Buffalo, N. Y., district, and furnaces in eastern Pennsylvania. Canadian ore was also used in Michigan and West Virginia blast furnaces.

PRODUCTION AND SHIPMENTS

Domestic iron-ore mines produced crude ore totaling 84,194,481 gross tons and shipped 83,985,686 tons in 1946, decreases of 21 percent in both cases from 1945. Of the 1946 shipments, 36 percent was sent to beneficiating plants and 64 percent went direct to consumers, as in 1945. From the crude ore shipped to beneficiating plants, 13,799,046 tons of concentrates and 2,522,698 tons of sinter were produced. In addition, 506,903 tons of byproduct ore in the form of cinder and sinter were produced by the pyrites industry during the year. In all, 70,843,113 gross tons of usable iron ore were produced at mines and mills in 1946. Of this quantity, 54,014,466 tons were suitable for consumption as mined without requiring further treatment in the form of concentration. The output in 1946 came from 191 mines, of which 19 mined over 1,000,000 tons of crude ore each. In addition to the mines, one plant, treating tailings produced in previous years, contributed toward the total output of usable ore. Minnesota, with 49,290,807 tons, supplied 70 percent of the usable ore, as in 1945, and Michigan, with 8,688,604 tons, or 12 percent, was the second largest producer. These two States and Wisconsin, with 1,062,743 tons or 2 percent, constitute the Lake Superior region, which supplied 84 percent of domestic output. About three-fourths of the iron ore mined in 1945 and 1946 came from open-pit mines.

Shipments of usable ore from mines totaled 70,090,410 gross tons in 1946; of this quantity, 53,901,452 tons (77 percent) were direct-shipping ore for use in iron and steel furnaces. Total shipments also include 9,478 tons of ore for cement manufacture, 9,167 tons for paint, and 14,041 tons for miscellaneous purposes. Shipments of byproduct ore for use in iron and steel included in the total shipments amounted to 596,358 tons in 1946, valued at $2,787,305.

Crude iron ore mined in the United States, 1945–46, by States and varieties, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	1945					1946				
	Number of mines	Hematite	Brown ore	Magnetite	Total	Number of mines	Hematite	Brown ore	Magnetite	Total
Alabama	[1] 21	5,704,605	2,551,510		8,256,115	20	5,782,894	2,183,829		7,966,723
California	3	141,823		138,750	280,573	2	325,491		15,000	340,491
Colorado	1	117			117	1	340			340
Georgia	[1] 5		1,352,050		1,352,050	8		1,303,395		1,303,395
Michigan	42	11,865,624			11,865,624	40	8,756,802			8,756,802
Minnesota	95	72,217,853			72,217,853	94	57,195,005			57,195,005
Missouri	[1] 2	253,591	4,000		257,591	2	380,536	536		381,072
Nevada	2			6,196	6,196	1			3,299	3,299
New Jersey	4			855,470	855,470	4			831,522	831,522
New Mexico	1			369	369					
New York	7	2,392		6,820,177	[2] 6,839,296	7	2,880		4,301,187	[3] 4,313,505
Pennsylvania	3					2				
Virginia	1		15,928			1		8,714		
South Dakota	1		4,162		4,162					
Texas	4	1,014	470,000		471,014	2	1,091	102,000		103,091
Utah	4			1,931,749	1,931,749	4			1,317,176	1,317,176
Wisconsin	2	1,368,215			1,368,215	2	1,062,743			1,062,743
Wyoming	1	606,005			606,005	1	619,317			619,317
Total	[1] 199	92,161,239	4,397,650	9,752,711	[2] 106,312,399	191	74,127,099	3,598,474	6,468,184	[3] 84,194,481

[1] Excludes an undetermined number of small pits. Output of these pits included in tonnage given.
[2] Includes 799 tons of carbonate ore.
[3] Includes 724 tons of carbonate ore.

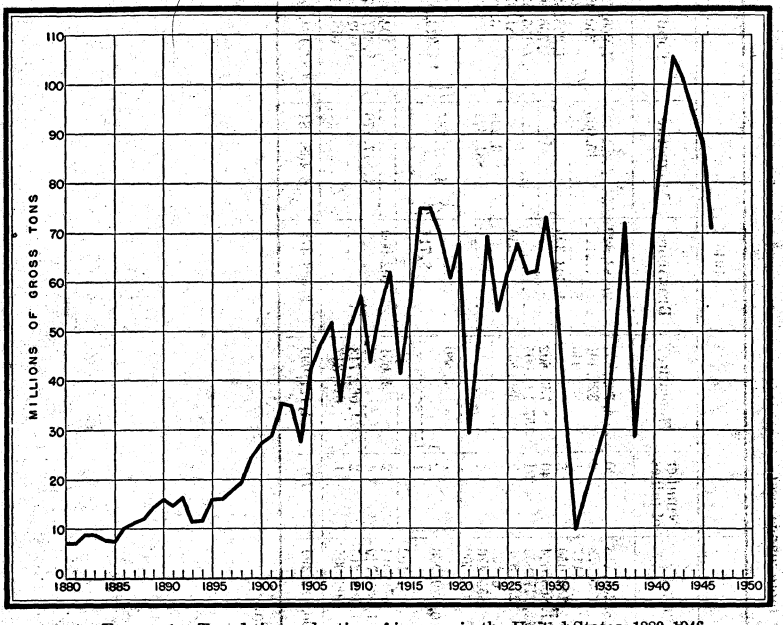

FIGURE 1.—Trends in production of iron ore in the United States, 1880–1946.

Crude iron ore mined in the United States, 1945–46, by States and mining methods, in gross tons

State	1945			1946		
	Open pit	Underground	Total	Open pit	Underground	Total
Alabama	2,551,510	5,704,605	8,256,115	2,258,405	5,708,318	7,966,723
California	280,573		280,573	340,491		340,491
Colorado	117		117	340		340
Georgia	1,352,050		1,352,050	1,303,395		1,303,395
Michigan	564,278	11,301,346	11,865,624	811,628	7,945,174	8,756,802
Minnesota	68,022,925	4,194,928	72,217,853	54,907,909	2,287,096	57,195,005
Missouri	257,591		257,591	381,072		381,072
Nevada	6,196		6,196	3,299		3,299
New Jersey		855,470	855,470		831,522	831,522
New Mexico	369		369			
New York	3,492,684	3,346,612	6,839,296	2,432,276	1,881,229	4,313,505
Pennsylvania						
Virginia						
South Dakota	4,162		4,162			
Texas	471,014		471,014	103,091		103,091
Utah	1,931,749		1,931,749	1,317,176		1,317,176
Wisconsin		1,368,215	1,368,215		1,062,743	1,062,743
Wyoming		606,005	606,005		619,317	619,317
	78,935,218	27,377,181	106,312,399	63,859,082	20,335,399	84,194,481

Crude iron ore shipped from mines in the United States, 1945–46, by States and disposition, in gross tons

State	1945			1946		
	Direct to consumers	To beneficiation plants	Total	Direct to consumers	To beneficiation plants	Total
Alabama	4,697,438	3,551,458	8,248,896	4,461,553	3,514,475	7,976,028
California	259,021	138,750	397,771	219,141	15,000	234,141
Colorado	117		117	340		340
Georgia		1,352,050	1,352,050		1,303,395	1,303,395
Michigan	11,816,671	49,515	11,866,186	8,449,102	99,552	8,548,654
Minnesota	47,127,414	25,302,406	72,429,820	37,537,956	19,808,661	57,346,617
Missouri	4,000	253,591	257,591	536	380,536	381,072
Nevada	6,196		6,196	3,299		3,299
New Jersey	126,394	725,482	851,876	134,394	656,843	791,237
New Mexico	369		369			
New York	124,140	6,701,524	6,825,664	62,936	4,196,904	4,259,840
Pennsylvania						
Virginia						
South Dakota	4,162		4,162			
Texas	1,014	470,000	471,014	941	102,000	102,941
Utah	1,925,572		1,925,572	1,321,334		1,321,334
Wisconsin	1,295,647		1,295,647	1,097,471		1,097,471
Wyoming	606,005		606,005	619,317		619,317
	67,994,160	38,544,776	106,538,936	53,908,320	30,077,366	83,985,686

Iron ore mined in the United States, 1945–46, by mining districts and varieties, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

Variety of ore	Lake Superior district	Birmingham	Chattanooga	Adirondack and Cornwall	New Jersey and S. E. New York	Other	Total
1945							
Crude ore:							
Hematite	85,451,692	5,704,605				1,004,942	92,161,239
Brown ore		716,700	1,435,550			2,245,400	4,397,650
Magnetite				6,820,177	855,470	2,077,064	9,752,711
Carbonate						799	799
	85,451,692	6,421,305	1,435,550	6,820,177	855,470	5,328,205	106,312,399
Iron ore:							
Hematite	74,821,045	5,612,962				860,681	81,294,688
Brown ore		144,044	292,745			506,121	942,910
Magnetite				3,185,402	430,308	2,005,100	5,620,810
Carbonate						545	545
	74,821,045	5,757,006	292,745	3,185,402	430,308	3,372,447	87,858,953
1946							
Crude ore:							
Hematite	67,014,550	5,782,894				1,329,655	74,127,099
Brown ore		263,000	1,247,900			2,087,574	3,598,474
Magnetite				4,301,187	831,522	1,335,475	6,468,184
Carbonate						724	724
	67,014,550	6,045,894	1,247,900	4,301,187	831,522	4,753,428	84,194,481
Iron ore:							
Hematite	59,042,154	5,581,747				1,104,271	65,728,172
Brown ore		52,991	267,880			365,531	686,402
Magnetite				2,175,290	417,529	1,328,167	3,920,986
Carbonate						650	650
	59,042,154	5,634,738	267,880	2,175,290	417,529	2,798,619	70,336,210

Iron ore produced in the United States, 1945–46, by States and types of product, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	1945					1946				
	Direct shipping ore	Sinter [1]	Concentrates	Total	Iron content, natural (percent)	Direct shipping ore	Sinter [1]	Concentrates	Total	Iron content, natural (percent)
Mined ore:										
Alabama	4,704,412	901,498	442,652	6,048,562	35.87	4,452,860	1,102,243	400,095	5,955,198	35.79
California	141,823		66,786	208,609	58.74	325,491		7,692	333,183	50.78
Colorado	117			117	56.20	340			340	56.18
Georgia			276,050	276,050	45.10			284,614	284,614	45.00
Michigan	11,816,109		16,384	11,832,493	51.83	8,657,250		31,354	8,688,604	51.82
Minnesota	46,944,837	112,451	14,563,049	61,620,337	52.08	37,386,434	96,350	11,808,023	49,290,807	51.48
Missouri	4,000		109,330	113,330	54.86	536		155,152	155,688	54.13
Nevada	6,196			6,196	64.14	3,299			3,299	65.17
New Jersey	126,673		303,635	430,308	63.58	134,111		283,418	417,529	63.67
New Mexico	369			369	60.00					
New York	113,312	2,263,050	818,852	3,195,214	63.82	53,818	1,324,105	808,181	2,186,104	62.19
Pennsylvania					56.40					56.35
Virginia					31.50					31.49
South Dakota	4,162			4,162	40.00					
Texas	1,014		216,223	217,237	46.71	1,091		20,517	21,608	50.73
Utah	1,931,749			1,931,749	52.84	1,317,176			1,317,176	53.73
Wisconsin	1,368,215			1,368,215	52.66	1,062,743			1,062,743	54.09
Wyoming	606,005			606,005	51.86	619,317			619,317	52.40
	67,768,993	3,276,999	16,812,961	87,858,953	51.33	54,014,466	2,522,698	13,799,046	70,336,210	50.59
Byproduct ore: [2]										
Michigan					66.00					
Delaware		517,440		517,440	59.98		506,903		506,903	63.06
Tennessee					68.01					68.40
Virginia					59.00					57.00
		517,440		517,440	64.76		506,903		506,903	65.80
Total	67,768,993	3,794,439	16,812,961	88,376,393	51.41	54,014,466	3,029,601	13,799,046	70,843,113	50.70

[1] Exclusive of sinter produced at consuming plants.
[2] Cinder and sinter obtained from pyrites treated in, but not necessarily mined in, States indicated.

Iron ore produced in the United States, 1945–46, by States and varieties, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	1945				1946			
	Hematite	Brown ore	Magnetite	Total	Hematite	Brown ore	Magnetite	Total
Alabama	5,612,962	435,600		6,048,562	5,531,747	373,451		5,935,198
California	141,823		66,786	208,609	325,491		7,692	333,183
Colorado	117			117	340			340
Georgia		276,050		276,050		284,614		284,614
Michigan	11,832,493			11,832,493	8,688,604			8,688,604
Minnesota	61,620,337			61,620,337	49,290,807			49,290,807
Missouri	109,330	4,000		113,330	155,152	536		155,688
Nevada			6,196	6,196			3,299	3,299
New Jersey			430,308	430,308			417,529	417,529
New Mexico			369	369				
New York	2,392				2,880			
Pennsylvania			3,185,402	3,195,214			2,175,290	2,186,104
Virginia		6,875				7,284		
South Dakota		4,162		4,162				
Texas	1,014	216,223		217,237	1,091	20,517		21,608
Utah			1,931,749	1,931,749			1,317,176	1,317,176
Wisconsin	1,368,215			1,368,215	1,062,743			1,062,743
Wyoming	606,065			606,065	619,317			619,317
	81,294,688	942,910	5,620,810	[1] 87,858,953	65,728,172	686,402	3,920,986	[2] 70,336,210
Byproduct ore: [3]								
Michigan								
Delaware								
Tennessee				517,440				506,903
Virginia								
Grand total	81,294,688	942,910	5,620,810	[1] 88,376,393	65,728,172	686,402	3,920,986	[2] 70,843,113

[1] Includes 545 tons of carbonate ore. [2] Includes 650 tons of carbonate ore.
[3] Cinder and sinter obtained from pyrites treated in, but not necessarily mined in, States indicated.

Shipments of iron ore in the United States in 1946, by States and uses, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	Iron and steel			Cement	Paint	Miscellaneous	Total	
	Direct shipping ore	Sinter [1]	Concentrates				Gross tons	Value
Mined ore:								
Alabama	4,461,553	1,102,017	430,230				5,993,800	$17,458,295
California	219,141					6,921	226,062	(2)
Colorado	340						340	(2)
Georgia			284,614				284,614	613,745
Michigan	8,446,071		31,354				8,477,425	28,297,890
Minnesota	37,537,956	96,350	11,421,034			486	49,055,340	142,049,316
Missouri	50		155,814				156,350	(2)
Nevada	3,299						3,299	(2)
New Jersey	134,394		275,672	5,026		4,182	419,274	3,052,831
New York	60,056			3,981	2,880	[3] 2,452		
Pennsylvania		1,329,425	412,887				1,817,968	13,257,927
Virginia					6,287	(2)		
Texas	941		20,517				21,458	(2)
Utah	1,320,863			471			1,321,334	1,372,109
Wisconsin	1,097,471						1,097,471	(2)
Wyoming	619,317						619,317	(2)
Undistributed								[2] 6,117,009
	53,901,452	2,527,792	13,032,122	9,478	9,167	14,041	69,494,052	212,219,122
Byproduct ore: [4]								
Delaware								
Tennessee		596,358					596,358	2,787,305
Virginia								
Grand total	53,901,452	3,124,150	13,032,122	9,478	9,167	14,041	70,090,410	215,006,427

[1] Exclusive of sinter produced at consuming plants.
[2] Values that may not be shown separately are combined as "Undistributed."
[3] Virginia included with New York.
[4] Cinder and sinter obtained from pyrites treated in, but not necessarily mined in, States indicated.

PRINCIPAL MINES

In this discussion, the size of a mine is determined by the quantity of crude ore excavated. Consequently, mines providing low-grade ores that require concentration will be comparable in size to mines producing similar quantities of direct-shipping ore. Nineteen mines, each yielding more than 1,000,000 gross tons of crude ore, produced 48 percent of the United States output in 1946. Of these producers, 13 were in Minnesota, 4 in Alabama, 1 in New York, and 1 in Pennsylvania; 13 were open-pit operations, 4 underground, and 2 combination mines. Except for two mines that produce magnetite, all the million-ton mines produced hematite in 1946. In 1945, 28 mines, producing more than 1,000,000 tons of ore each, produced 56 percent of the United States output.

There were 26 mines in 1946 that produced between 500,000 and 1,000,000 tons of crude ore each. These mines produced one-fifth of the United States total of crude ore, and two-thirds was obtained from mines with production of over half a million tons of crude ore. These mines are listed in detail in the following table.

Iron-ore mines in the United States in 1946, by size of crude output

Name of mine	State	Nearest town	Range or district	Mining method	Production (gross tons)	
					Crude ore	Usable ore
Hull-Rust-Burt-Sellers-Penobscott.	Minnesota	Hibbing	Mesabi	Open pit	[1] 3,030,373	12,903,655
Rouchleau-Moose	do	Virginia	do	do	3,703,888	3,703,888
Mountain Iron	do	do	do	do	3,185,336	3,168,021
Hill Annex	do	Calumet	do	do	2,835,340	1,672,593
Spruce	do	Eveleth	do	Combined	1,439,992	1,439,992
Mahoning	do	Hibbing	do	Open pit	1,385,326	1,385,326
Cornwall	Pennsylvania	Lebanon	Cornwall	Combined	2,021,509	1,260,107
New Bed-Harmony and Old Bed.	New York	Mineville	Adirondack	Underground		
Muscoda	Alabama	Bessemer	Birmingham.	do	1,332,504	[1] 3,719,846
Wenonah	do	do	do	do	1,306,496	[2]
Gross Marble	Minnesota	Marble	Mesabi	Open pit	1,158,968	651,849
Mississippi	do	Keewatin	do	do	1,157,949	823,650
MacIntyre	New York	Tahawus	Adirondack	do	1,155,454	453,357
Ishkooda	Alabama	Bessemer	Birmingham.	Underground	1,126,686	[2]
Pyne	do	do	do	do	1,109,942	1,109,942
Embarrass	Minnesota	Biwabik	Mesabi	Open pit	1,083,871	1,083,871
Fraser	do	Chisholm	do	do	1,056,154	1,054,666
Hill-Trumbull	do	Marble	do	do	1,050,359	590,040
Canisteo	do	Coleraine	do	do	1,039,895	547,398
Susquehanna	do	Hibbing	do	do	1,034,569	971,783
Morrison-Lewis-Walker.	do	Coleraine	do	do	946,606	717,951
Hodge Mining Co	Georgia	Taylorsville	Chattanooga.	do	917,795	201,713
Missabe Mountain	Minnesota	Virginia	Mesabi	do	893,451	893,451
Montreal	Wisconsin	Montreal	Gogebic	Underground	857,227	857,227
Wabigon	Minnesota	Buhl	Mesabi	Open pit	787,431	691,614
Iron Mountain	Utah	Cedar City	Iron Mountain.	do	784,035	784,035
Carol	Minnesota	Nashwauk	Mesabi	do	783,837	388,832
North Harrison	do	Cooley	do	do	758,252	269,681
Holman-Brown	do	Taconite	do	do	714,226	434,535
Buckeye	do	Grand Rapids.	do	do	697,299	414,141
Russellville Nos. 5 and 12.	Alabama	Russellville	Russellville	Open pit	680,514	101,053

[1] Includes Ishkooda and Wenonah.
[2] Included with Muscoda.

Iron-ore mines in the United States in 1946, by size of crude output —Con.

Name of mine	State	Nearest town	Range or district	Mining method	Production (gross tons)	
					Crude ore	Usable ore
Prindle	Minnesota	Virginia	Mesabi	Open pit	653,986	558,730
Morris	do	Hibbing	do	do	652,572	652,572
Draper Annex	do	Greenway Twp.	do	do	639,122	456,558
Scranton	do	Hibbing	do	do	630,121	630,121
Webb	do	do	do	Combined	630,021	598,827
Sunrise	Wyoming	Sunrise	Hartville	Underground	619,317	619,317
Danube	Minnesota	Bovey	Mesabi	Open pit	602,676	403,280
Portsmouth Group	do	Crosby	Cuyuna	do	600,857	515,657
Olson	do	Cooley	Mesabi	do	591,141	214,367
Scranton-South Rust	do	Hibbing	do	do	567,378	567,378
Bennett	do	Keewatin	do	do	565,371	519,579
Argonne	do	Nashwauk	do	do	555,968	290,382
Godfrey	do	Chisholm	do	Underground	535,106	535,106
Columbia	do	Virginia	do	Open pit	527,822	511,283
Output of 45 mines producing more than 500,000 tons crude ore each					58,406,742	49,368,534
Output of 16 mines producing 400,000 to 500,000 tons crude ore each					7,119,556	5,666,200
Output of 18 mines producing 300,000 to 400,000 tons crude ore each					6,236,645	5,321,139
Output of 27 mines producing 200,000 to 300,000 tons crude ore each					6,302,350	5,735,443
Output of 25 mines producing 100,000 to 200,000 tons crude ore each					3,551,555	2,735,388
Output of 17 mines producing 50,000 to 100,000 tons crude ore each					1,285,774	1,002,380
Output of 43 mines producing under 50,000 tons crude ore each					535,589	404,930
Output from reprocessed tailings (1 plant)					226,070	107,196
Grand total of United States (191 mines and 1 reprocessing plant)					84,194,481	70,386,220

SINTER

Domestic sintering plants in 1946 used 8,066,427 gross tons of iron ore, 4,031,125 tons flue dust, 627,907 tons pyrites cinder, and 171,097 tons of mill cinder and roll scale to produce 11,818,777 tons of sinter—a conversion yield of 92 percent.

Sinter production in 1946 came from plants at mines, blast-furnace plants, and custom mills. Of the sinter produced in the United States in 1946, 21 percent was made at mine plants in 4 States, and 79 percent was produced at blast-furnace plants and custom mills in 12 States.

Production and consumption of sinter in the United States in 1946, by States, in gross tons

State	Sinter produced	Sinter consumed	
		In blast furnaces	In steel furnaces
Alabama	1,251,318	1,436,841	54,979
California, Colorado, Utah	580,794	586,245	
Delaware	110,404		
Illinois	539,768	538,803	63
Indiana	715,553	634,441	71,632
Maryland, Kentucky, Tennessee, West Virginia	400,685	443,294	61,452
Michigan	269,496	236,567	30,689
Minnesota	96,350		
New York	1,656,549	693,246	44,416
Ohio	3,001,793	2,982,788	278,631
Pennsylvania	3,196,067	3,016,977	145,317
	11,818,777	10,569,202	687,179

REVIEW OF LAKE SUPERIOR DISTRICT

Production and Shipments.—Production of iron ore from mines and mills in the Lake Superior district in 1946 was 21 percent lower than in 1945, but the district retained its usual position as the major supplier of domestic ore, and 84 percent of the United States total was obtained from the area. The Mesabi, largest of the six producing ranges, supplied 79 percent of the district total and 66 percent of the United States total, as in 1945. In addition to the 59,042,154 gross tons of iron ore produced in the Lake district, 953,073 tons of manganiferous ore (containing 5 percent or more Mn) were produced, making a total output of all grades of 59,995,227 tons. The total shipments of 59,587,956 tons consisted of 957,720 tons containing over 5 percent manganese and 58,630,236 tons containing less than 5 percent. The ore produced in Wisconsin in 1946 was from the Gogebic range, which extends into Michigan. The ore came from the Montreal mine of Oglebay Norton & Co. and the Cary-Tilden operated by Pickands, Mather & Co. This ore is shipped to consuming points near the Great Lakes.

Production and shipments from Canadian mines in the Lake Superior district are not included in these statistics. Shipments from those mines in 1946 totaled 1,440,640 gross tons; of this quantity, 830,481 tons came from the Steep Rock mine, 552,056 tons came from the Helen and Victoria mines, and 58,103 from the Josephine.

The Lake Superior Iron Ore Association reported 59,587,730 tons of iron and manganiferous ore shipped to upper Lake ports from United States mines in 1946, a decrease of 20 percent from 1945. All-rail shipments totaled 1,491,856 tons in 1946, compared with 1,208.710 tons in 1945. The Lake shipping season opened unusually early (March 25 at Sault Locks), but no iron ore moved in March, and only 730,000 tons moved by the end of April because of the iron-ore strike, which had been in effect since February 8. This level of production during April was only about one-tenth that of April 1945, and it was not until May 25, when 11 companies, representing 93 percent of the annual shipping capacity of the Lake Superior region, had signed agreements with the Union, that output attained near-normal levels. The final cargo of Lake Superior iron ore for the 1946 season was loaded at Superior, Wis., on December 6, one day later than the final loading in the preceding year.

The railroads serving the iron-ore mines in the Lake Superior region applied to the Interstate Commerce Commission on April 15, 1946, for increases of 12 cents a ton in rail freight and 3 cents in dock charges on iron ore, both at upper and lower Lakes. After the hearings in May, the Commission granted temporary increases of 3 cents per ton in the upper Lake rates, 0.5 cent in the dock charges, and 2 cents in the lower Lake rates. However, after further hearings and considerations of the case, the Commission, on December 5, 1946, canceled the increases previously granted in June on the upper Lake rates and dock charges, but authorized a full 12 cents per ton increase in other rail charges on iron ore and 25 percent increase in dock handling and other charges. Lake vessel rates on iron ore also were increased effective July 1, 1946. The increase amounted to 10 cents a gross ton from the head of the Lakes and ranged down to 6 cents

increase on the shortest haul from Escanaba. The railroad rate increases changed the rate from Mesabi and Vermilion ranges to Duluth, Superior, and Two Harbors from 92 cents to $1.04 per ton, and a 10-cent increase in Lake shipping rates from upper Lake ports raised its charge from 94 cents to $1.04.

Iron ore produced in the Lake Superior district, 1854–1946, by ranges, in gross tons

[Exclusive after 1905 of ore containing 5 percent or more manganese]

Year	Marquette	Menominee	Gogebic	Vermilion	Mesabi	Cuyuna	Total
1854–1941	213,048,628	191,272,379	225,607,448	70,520,400	1,178,414,192	27,987,266	1,906,850,313
1942	6,324,307	4,808,866	5,993,575	1,935,125	70,287,664	1,655,484	91,005,021
1943	5,680,727	5,366,595	5,877,215	1,782,237	65,334,939	1,747,304	85,789,017
1944	4,720,253	4,288,830	5,224,142	1,466,816	61,994,023	1,417,250	79,111,320
1945	4,664,816	4,140,239	4,395,653	1,481,007	58,355,320	1,784,010	74,821,045
1946	3,455,961	2,662,308	3,633,078	1,232,008	46,678,679	1,380,120	59,042,154
Total	237,894,692	212,539,217	250,731,111	78,417,593	1,481,064,817	35,971,440	2,296,618,870

Analyses.—The following table shows average analyses from the Lake Superior district.

Average analyses of total tonnages (bill-of-lading weights) of all grades of iron ore from all ranges of Lake Superior district, 1942–46

[Lake Superior Iron Ore Association]

Year	Gross tons	Iron (natural), percent	Phosphorus (percent)	Silica (percent)	Manganese (percent)	Moisture (percent)
1942	92,069,902	51.65	0.089	8.21	0.79	10.98
1943	85,116,347	51.58	.091	8.32	.82	11.06
1944	81,039,404	51.72	.088	8.42	.74	11.02
1945	75,206,781	51.69	.089	8.52	.72	10.96
1946	58,975,188	51.32	.087	8.83	.74	11.22

Reserves.—The accompanying tables show reserves of iron ore in Michigan and Minnesota. It should be borne in mind that these data represent only taxable and State-owned reserves and do not represent the total that may be expected to become available. Additional tonnages are added to the reserve figures each year, and undoubtedly ultimate production in the Lake Superior district will greatly exceed that indicated by present reserve tonnages.

The Wisconsin Department of taxation estimated reserves of iron ore in Wisconsin to be 6,000,000 tons on January 1, 1947.

Iron-ore reserves in Michigan, January 1, 1943–47, in gross tons

[Michigan Department of Conservation]

Range	1943	1944	1945	1946	1947
Gogebic	32,901,951	32,791,848	32,686,550	31,828,392	31,331,775
Marquette	50,991,701	49,852,024	51,357,761	51,648,430	62,228,925
Menominee	55,563,724	53,902,631	50,376,403	48,260,784	49,298,678
Total Michigan	139,457,376	136,346,503	134,420,714	131,737,606	142,859,378

Unmined iron-ore reserves in Minnesota, May 1, 1942–46, in gross tons

[Minnesota Department of Taxation]

	1942	1943	1944	1945	1946
Mesabi	1,069,752,650	1,043,804,391	1,020,138,504	962,290,748	924,903,098
Vermilion	14,903,353	13,449,980	12,636,820	12,349,903	11,523,341
Cuyuna	64,411,762	63,559,455	62,059,815	59,659,027	59,061,587
Total Minnesota (Lake Superior district)	1,149,067,765	1,120,813,826	1,094,835,139	1,034,299,678	995,488,026
Filmore County	250,000	259,859	231,393		
State ore (not taxable)	31,978,475	16,672,818	13,000,996	19,865,715	19,950,255
Total Minnesota	1,181,296,240	1,137,746,503	1,108,067,528	1,054,165,393	1,015,438,281

Stocks at Lake Erie Ports.—On December 1, 1946, just before navigation stopped, the Lake Superior Iron Association reported 4,856,537 gross tons of iron ore at Lake Erie ports, compared with 4,814,991 tons in 1945. At the opening of the 1947 season (May 1, 1947), 1,816,400 tons of ore were in stock at these ports, compared with 3,019,184 tons on May 1, 1946. Thus, withdrawals from stocks during this 5-month period in 1946–47 were about two-thirds greater than those of a year ago.

Prices of Lake Superior Ore.—The prices of Lake Superior ore at the beginning of the 1946 shipping season were higher than in 1945 by 10 to 20 cents per gross ton as a result of an increase granted by the Office of Price Administration on December 29, 1945. Following the strike at iron mines a further increase of 50 cents per ton was allowed (effective June 24, 1946), and the prices were then $5.05 for Mesabi non-Bessemer grade and $5.30 for Old Range non-Bessemer grade. The strike was settled at most mines between early March and May on the same basis as in the steel industry, with hourly wage increases of 18½ cents. Prices for Bessemer ores at the close of 1946 were $5.45 for Old Range and $5.20 for Mesabi ore. Old Range non-Bessemer was $5.30 and Mesabi non-Bessemer $5.05. High-phosphorus ore was also $5.05.

Mining Developments.—A recent trend in material handling in the Lake Superior region is toward greater use of conveyor belts with some lessening of truck haulage, but utilizing larger trucks with as high as double the capacity of the usual 15- or 20-ton trucks. One large 25-yard dragline excavator is being used for stripping, the overburden being piled entirely by means of conveyor belts. An underground mine in the Menominee district of Michigan has been equipped with a belt conveyor for main haulage in its deepest level, with lateral shaker conveyors to feed the ore to it. Shakers are also in use in other mines on the Menominee and the Mesabi. The trend in conveyor belts is toward longer units and to cotton- or steel-cord belts. At one Mesabi pit where a former rail hauling system is being replaced by a conveyor to deliver ore directly to the washing plant, tailing disposal is to be made through a 14-inch pipeline about 7,500 feet long.

To replace churn drillings, a new method, called fusion piercing, has a promising future.[1] In this process a blast hole is burned with a

[1] Blast Furnace and Steel Plant, Fusion Piercing Blasts Holes Ten Times Faster Than by Drilling: Vol. 35, No. 1, January 1947, p. 59.
Canadian Mining Journal, Fusion Piercing: Vol. 67, No. 11, November 1946, pp. 1043–1045.

rotating multiple-port blowpipe, and the debris is blown out by steam produced by water introduced behind the torch. With a field outfit in use for the first time in the fall of 1946, working on the extremely hard and tough magnetic taconite in the vicinity of Babbitt on the eastern Mesabi, progress of 4 to 17 feet an hour, as compared with 1 foot per hour for churn drills, was reported. Holes are chambered by retarding the advance of the torch. Experimental work on this project has been under way in the United States for some time by the Linde Air Products Co.

A symposium devoted to underground mining was held at Duluth in January 1946 with a view to reducing costs in underground mining and making the method more competitive with lower-cost open-pit operations. It was indicated that top slicing, with its high timber requirements, is yielding to sublevel caving methods, and block caving, which has not been used in the district since 1898, is about to be retried.

Research was continued through 1946 by private mining companies, the Minnesota Mines Experiment Station, and the Battelle Memorial Institute of Columbus, Ohio. At the close of the year plans were being made for the construction of two plants for the manufacture of high-grade concentrates from the magnetic taconites of the eastern Mesabi. A pilot plant to produce iron powder was being erected near Aurora on the eastern Mesabi. The latter project was sponsored by the State of Minnesota and was expected to be in production early in 1947. The plant was to treat 50 tons a day of low-grade iron carbonate ore to produce 5 or more tons of iron powder for commercial use.

Average costs, per gross ton, of mining iron ore at underground mines and at siliceous open pits in Michigan in 1946 [1]

Item	Underground				Siliceous open pits
	Gogebic	Marquette	Menominee	Average	
Cost of mining:					
Labor	$1.7467	$1.9427	$1.2996	$1.6781	$0.4029
Supplies	.7837	.7789	.5749	.7128	.2753
Deferred costs	.1675	.0514	.1645	.1197	.0448
Taxes	.3635	.2889	.1637	.2673	.0819
General overhead	.2477	.2142	.1640	.2064	.1627
Transportation	2.0165	1.7053	1.7913	1.8358	1.6861
Marketing	.0599	.0209	.0883	.0537	.0488
Total ore cost	5.3855	5.0023	4.2463	4.8738	2.7025
Lake Erie value per ton	5.4918	5.4468	4.9098	5.3123	2.9872
Gross ore profit [2]	.1063	.4445	.7535	.4385	.2847
Other costs:					
Royalty	.3592	.2140	.2607	.2701	.1008
Interest on borrowed money		.0311	.0015	.0130	.0087
Federal income and excess profits	.1334	.0729	.2909	.1616	.0905

[1] Pardee, F. G., Kennedy, Bruce E., General Statistics Covering Costs and Production of Michigan Iron Mines: Michigan Dept. of Conservation, Geol. Survey Div., 1946, 9 pp.
[2] This figure does not represent true profit, as much ore is sold below the Lake Erie price.

MINING BY STATES

Alabama.—Production of crude ore in Alabama, the third largest producing State, dropped 4 percent in 1946 from 1945, whereas production for the United States as a whole fell 21 percent. Output of usable brown ore, all from open-pit operations, declined 14 percent, and that of hematite, mostly from underground mines, 1 percent.

Iron ore mined in the United States in 1946, by States and counties, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State and county	Active mines	Crude ore	Usable ore
Alabama:			
Bibb	1	172,000	34,568
Calhoun	2	2,105	555
Cherokee	2	87,000	17,340
Colbert	1	413,210	53,858
Franklin	2	1,177,514	200,435
Jefferson	9	5,782,894	5,581,747
St. Clair	1	241,000	48,272
Shelby	1	68,000	13,755
Tuscaloosa	1	23,000	4,668
	20	7,966,723	5,955,198
California:			
San Bernardino	1	325,491	325,491
Shasta	1	15,000	7,692
	2	340,491	333,183
Colorado: Lake	1	340	340
Georgia:			
Bartow	3	961,795	210,637
Polk	5	341,600	73,977
	8	1,303,395	284,614
Michigan:			
Dickinson	2	49,957	49,957
Gogebic	8	2,570,335	2,570,335
Iron	15	2,680,549	2,612,351
Marquette	15	3,455,961	3,455,961
	40	8,756,802	8,688,604
Minnesota:			
Crow Wing	9	1,574,618	1,380,120
Itasca [1]	31	16,310,335	9,553,410
St. Louis	55	39,310,052	38,357,277
	95	57,195,005	49,290,807
Missouri:			
Howell	1	536	536
St. Francois	1	380,536	155,152
	2	381,072	155,688
Nevada: Pershing	1	3,299	3,299
New Jersey:			
Morris	3	831,522	417,529
Warren	1		
	4	831,522	417,529
Virginia: Pulaski	1		
New York:			
Clinton	1		
Essex	3		
Oneida	1	4,312,781	2,185,454
St. Lawrence	2		
Pennsylvania:			
Lebanon	1		
Carbon	1	724	650
	10	4,313,505	2,186,104
Texas:			
Cass	1	103,091	21,608
Llano	1		
	2	103,091	21,608
Utah: Iron	4	1,317,176	1,317,176
Wisconsin: Iron	2	1,062,743	1,062,743
Wyoming: Platte	1	619,317	619,317
	192	84,194,481	70,336,210

[1] Includes output of 1 plant reprocessing tailings.

The Sloss-Sheffield Steel & Iron Co. mined hematite from open-pit operations at the Ruffner and Sadler Gap mines in Jefferson County. High-density separation was employed at the Ruffner mine as an essay in treating Alabama hematite. The Republic Steel Corp. shipped mostly sinter from its Spaulding operation in Jefferson County, but some direct ore and concentrate were shipped. In this operation, concentrates from the Spaulding mine and pyrites cinder from Pulaski, Va., are used to produce the sinter, but in recording the tonnage, the sinter made from pyrites cinder is deducted and credited as byproduct production from Virginia. The Tennessee Coal, Iron & Railroad Co. produced and shipped ore from its Red Mountain mines, composed of the Muscoda, Wenonah, and Ishkooda groups; some of the ore

was sintered before consumption, and the rest was crushed and blended and shipped direct to furnaces. Other hematite producers in the Birmingham district in 1946 were the Pyne and Woodward No. 3 mines of the Woodward Iron Co. in Jefferson County. The hematite shipped from Alabama in 1946 averaged (natural) 35.20 percent Fe, 0.15 percent Mn, 0.30 percent P, 16.00 percent SiO_2, 14.61 percent CaO, and 1.44 percent H_2O.

Brown ore was shipped from 3 mines in the Birmingham district, 5 mines in the Chattanooga district, and 3 other mines, 1 in Colbert County and 2 in Franklin County. The largest brown-ore operation in Alabama in 1946 was the Russellville No. 5 and 12, operated by the Sloss-Sheffield Steel & Iron Co. Brown ore shipped in 1946 averaged (natural) 44.6 percent Fe, about 0.5 percent Mn, 0.5 percent P, approximately 10 percent SiO_2, and 7 percent moisture.

California.—The production of iron ore in California in 1946 consisted of hematite from the Vulcan mine in San Bernardino County and magnetite from the Shasta and California mines in Shasta County. The ore from Shasta was used entirely as ballast, whereas the Vulcan ore was shipped to the Kaiser Co., Inc., Fontana. The latter ore averaged (natural) 50.44 percent Fe, 0.13 percent Mn, 0.046 percent P, 6.24 percent SiO_2, 4.00 percent CaO, and 0.50 percent H_2O. Most of the iron ore for the Fontana furnace was obtained from Utah.

The Kaiser Co., Inc., announced in May 1946 that it had acquired all outstanding rights and interests in the Eagle Mountain iron-ore mine in Riverside County.

The Shasta and California iron-ore deposits were described by Lamey.[2]

Colorado.—The Stiron Metals, Ltd., shipped hematite from the Bruce mine in Lake County to the Colorado Fuel & Iron Corp., Pueblo.

Georgia.—All of the output from Georgia in 1946 was brown ore from Bartow and Polk Counties. This ore, as mined, was very low-grade, and all was washed before shipping. Approximately 1,300,000 tons of material was mined and washed during the year. From this material, a total of 284,614 tons of usable ore was produced, or a ratio of nearly 5 tons of crude to 1 ton of usable. The Hodge Mining Co., operating in Bartow County, produced most of the ore, as in 1945.

Michigan and Minnesota.—See Review of Lake Superior District.

Missouri.—Most of the ore produced in Missouri in 1946 was hematite from the Iron Mountain mine in St. Francois County. This ore was concentrated by jigging, and the usable ore averaged (natural) 54.17 percent Fe. A small quantity of brown ore was shipped by Doane and Ives from the Kingsbury mine in Howell County. Some of this ore was used as lump ore in open-hearth furnaces, but most of it was used as flux in nonferrous smelter operations.

Nevada.—A. N. Bratton shipped magnetite for use in steel furnaces during 1946. This ore averaged (dry) 65.18 percent Fe and came from Pershing County.

[2] Lamey, Carl A., Shasta and California Iron Ore Deposits in Shasta County, Calif.: Iron Ore Reserves of California, Bull. 129, October 1946, 164 pp.

New Jersey.—All of the ore produced in New Jersey in 1946 was magnetite from underground mines in Morris and Warren Counties. The ore was concentrated by magnetic and gravity separation and averaged (natural) 63.67 percent Fe. Production in New Jersey was virtually at the 1945 level despite strikes, which prevented maximum operation during the first half of the year.

New York.—The Republic Steel Corp. shipped magnetite concentrates and sinter from its Chateaugay mine, Clinton County, and Fisher Hill and New Bed-Harmony-Old Bed group, Essex County. High-grade lump ore is hand-sorted from Old Bed, and the remainder is concentrated magnetically, and most of it sintered before shipping. The Jones & Laughlin Ore Co. shipped concentrate and sintered magnetite from the Benson mine in St. Lawrence County; the company purchased the concentrating and sintering plants at this mine from the Reconstruction Finance Corporation during the year. The Hanna Iron Ore Co. shipped from the Clifton mine in St. Lawrence County sinter averaging (natural) 62.68 percent Fe. The National Lead Co. shipped magnetite concentrates and sinter from the MacIntyre development in Essex County. This material is obtained as a byproduct in the recovery of ilmenite from titaniferous magnetite.

The hematite produced in New York came from the mine of Clinton Metallic Paint Co. in Oneida County.

Pennsylvania.—Except for the small tonnage of carbonate ore from Garbon County, the entire output consisted of magnetite from the Cornwall mine near Lebanon. The ore from Cornwall is shipped to Lebanon, where it is concentrated magnetically and treated further by flotation to remove chalcopyrite and other minerals. Some magnetite concentrate is sintered and some is shipped to consuming plants for sintering.

The Prince Manufacturing Co. mined the carbonate ore for use in paint from the Hazard and Little Gap mine.

Texas.—Peter M. Chamberlain, operating a property in Cass County under lease from the War Assets Administration, produced and shipped brown ore averaging (natural) 49.97 percent Fe to blast furnaces in the Birmingham area. Hematite lump ore was mined by Tillie B. Moss from the Moss mine in Llano County.

Utah.—Mines in Utah supplied semialtered magnetite to blast furnaces at Provo and Geneva, Utah; Pueblo, Colo.; and Fontana, Calif. The Iron Mountain mine supplied ore to the Utah furnaces, the Duncan mine shipped to Pueblo, and the Excelsior mine, operated by the Utah Construction Co., shipped ore to Fontana. Helene E. Beatty produced ore for open-hearth use from the Great Western mine. All of the ore was mined by open-pit methods and averaged (natural) 53.73 percent Fe.

Virginia.—All of the ore produced in Virginia in 1946 was used as a pigment and was obtained from Pulaski County.

Wisconsin.—See Review of Lake Superior District.

Wyoming.—The Colorado Fuel & Iron Corp. produced and shipped hematite for its Pueblo furnaces from the Sunrise mine in Platte County during 1946. The ore averaged (natural) 52.40 percent Fe.

CONSUMPTION

A total of 72,174,844 gross tons of iron ore was reported consumed in 1946. Of this, 84 percent was consumed in iron blast furnaces, 11 percent in sintering plants, 4 percent in steel furnaces, and less than 1 percent in ferro-alloy furnaces; manufacture of cement, ballast blocks, paints, and other items used small quantities. In addition to the iron ore used in blast and steel furnaces, blast furnaces consumed 10,569,202 tons of iron-ore sinter and steel furnaces used 687,179 tons of sinter.

Consumption of iron ore in the United States, in 1946, by States and uses, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

State	Metallurgical uses				Miscellaneous uses			Total
	Iron blast furnaces	Steel furnaces	Sintering plants	Ferro-alloy furnaces	Cement	Paint	All other [1]	
Alabama	5,260,875	16,468	1,106,819		42,629			6,426,791
California	1,531,589	100,913	619,647		48,172	[2]	[2]	2,310,755
Colorado					1,715			
Utah					107		471	
Illinois	6,537,866	256,107	273,870		[2]	[2]		7,070,784
Indiana	7,424,629	453,618	371,404		44			8,249,695
Kentucky			3,060					
Maryland	3,233,167	325,093			[2]	[2]		3,562,680
Massachusetts								
Michigan	1,937,301	227,622	122,976					2,293,307
Tennessee					5,408			
Minnesota	879,434	211,872	118,314					1,069,620
Missouri					131		486	617
New Jersey						[2]	[2]	9,221
New York	3,738,030	223,013	1,371,571	112,621	4,212	[2]	[2]	5,456,569
Ohio	11,432,601	502,746	2,287,126	129,615	[2]	[2]		14,357,914
Pennsylvania	16,968,368	991,777	1,791,640	6,553	8,473	30,693		19,797,504
West Virginia	1,518,016	13,258						1,531,274
Texas					13,168			13,168
Virginia					3,151	[3]	[3]	13,791
Washington					182			182
Other States					[3] 6,610	[4] 4,362		10,972
	60,461,276	3,182,487	8,066,427	248,789	137,876	54,470	23,519	72,174,844

[1] Shipments from domestic mines.
[2] Not at liberty to show separately; included in total.
[3] Florida, Kansas, Maine, Montana, Oklahoma, and Oregon.
[4] Georgia, North Dakota, and Wisconsin.

STOCKS

Stocks of usable iron ore at mines on December 31, 1946, increased 20 percent over 1945. Of the quantity in stock piles, 37 percent was at mines in Michigan, 31 percent in Minnesota, and 24 percent in New York. Including 3 percent at mines in Wisconsin, the Lake Superior district held 71 percent of the total stocks at the end of the year. Stocks of crude ore at mines totaled 3,096,426 gross tons on December 31, 1946, compared with 2,685,495 tons in 1945.

Stocks of iron ore at consuming plants totaled 33,661,856 gross tons on December 31, 1946, compared with 34,642,259 tons at the end of 1945.

Stocks of usable iron ore at mines, December 31, 1945–46, by States, in gross tons

State	1945	1946	State	1945	1946
Alabama	54,284	20,542	New York	999,690	1,278,380
California	114,493	219,800	Pennsylvania	6,651	5,803
Michigan	1,775,824	1,985,715	Virginia		150
Minnesota	1,355,035	1,656,275	Texas	19,652	15,093
Missouri	693		Utah	189,870	155,142
Nevada	1,786		Wisconsin		
New Jersey	3,992	2,247	Total	4,431,970	5,339,147

PRICES

The average value per gross ton of iron ore at mines was $3.07 in 1946, compared with $2.77 in 1945.

The accompanying table gives the average value at mines of the different classes of iron ore in 1946 for each of the producing States or group of States except when there are fewer than three shippers of a certain class of ore in a State and permission has not been given to publish the value. These data are taken directly from statements of producers and probably represent the commercial selling prices only approximately. In general, the delivered cost less transportation costs to the consuming plant is given. In the Lake Superior district the mine value is the Lake Erie price less freight from mines to lower Lake ports. This value appears to be applied also to ore that is not sold on the open market.

Average value per gross ton of iron ore at mines in the United States, 1945–46

[Exclusive of ore containing 5 percent or more manganese]

State	1945							1946						
	Direct			Concentrates				Direct			Concentrates			
	Hematite	Brown ore	Magnetite	Hematite	Brown ore	Magnetite	Sinter	Hematite	Brown ore	Magnetite	Hematite	Brown ore	Magnetite	Sinter
Mined ore:														
Alabama	$2.23			(1)	$2.72		(1)	$2.70			(1)	$2.85		(1)
Georgia					2.23							2.16		
Michigan	2.98			(1)				3.34			(1)			
Minnesota	2.52			$2.63			(1)	2.82			$3.15			(1)
New Jersey			(1)			$7.01				(1)			$7.34	
New York	(1)		(1)			5.94	$7.64	(1)					5.76	$7.54
Pennsylvania					(1)									
Utah			$1.13							$1.04				
Other States[2]	2.40	$4.94	6.29	4.53	4.33	7.91		2.71	$3.46	5.61	4.84	16.72	7.00	
Average, all States	2.58	4.94	1.69	2.64	2.96	6.44	6.27	2.89	3.46	1.79	3.17	3.38	6.40	5.66
Byproduct ore:[3]														
Delaware														
Michigan														
Pennsylvania							4.96							4.67
Tennessee														
Virginia														

[1] Included with average for all States.
[2] Includes New Mexico and South Dakota in 1945 and California, Colorado, Missouri, Nevada, Texas, Virginia, Wisconsin, and Wyoming in 1945 and 1946.
[3] Cinder and sinter obtained from pyrites treated in, but not necessarily mined in, States indicated.

FOREIGN TRADE [3]

Imports of iron ore were nearly double the quantity exported in 1946. Exports, of which virtually all went to Canada, totaled 1,505,854 gross tons valued at $5,492,549. Canada received 1,505,608 tons, valued at $5,487,348; very small quantities were exported to Mexico, Cuba, Netherlands Indies, and Australia. Imports by countries are given in the accompanying table. Notable among these data was the increase of receipts from Chile, which approximated those of the prewar years. Imports from Canada were high but were exceeded by United States exports to that country during the year. Receipts from Newfoundland were resumed after having been cut off during the war period, as were receipts of high-grade Swedish ore, which neared a quarter of a million tons in 1946. Receipts from Algeria dropped to about one-third the 1945 level.

Iron ore imported for consumption in the United States, 1944–46, by countries, in gross tons

Country	1944		1945		1946	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Algeria	134,104	$555,703	221,526	$930,807	83,381	$291,873
Argentina					18	136
Belgium and Luxembourg					1,200	3,600
Brazil	7	37			3	24
Canada [1]	255,431	1,191,936	704,225	2,618,069	1,102,852	5,085,888
Chile			214,670	386,406	1,095,627	2,459,704
Colombia	10	33				
Cuba	96	695	145	1,053	158,268	749,654
Denmark					24,458	150,001
France			2,419	7,257	3,969	10,999
Greece					2,000	6,000
Italy			500	2,000	500	1,000
Mexico	62,630	183,335	37,728	81,098	789	1,070
Morocco, French	7,449	37,085	1,200	6,000	5,550	17,600
Newfoundland and Labrador					15,560	62,000
Peru			13	60		
Spain					4	20
Sweden					232,887	1,384,993
Tunisia	3,539	22,597	10,382	37,120	26,873	121,233
Union of South Africa					2	100
United Kingdom	266	16,444	706	30,474	335	24,780
	463,532	2,007,865	1,193,514	4,100,344	2,754,216	10,370,675

[1] Includes pyrites cinder.

BENEFICIATION

Iron ore as mined may be classified broadly as direct-shipping and concentrating-grade ore. The direct-shipping ore is high enough in grade and otherwise suitable for smelting without further treatment. The concentrating-grade ore is usually low-grade and contains undesirable impurities and must be treated before being used. Such ore is

[3] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

concentrated by washing, jigging, tabling, magnetic concentration, and high density separation to remove impurities, thereby improving its grade. Fine ores are often agglomerated or sintered into lumps, which are desirable in blast and steel furnaces because of their improved structure and grade. Sintering likewise has a beneficial effect by reducing the sulfur and moisture content. At some mines ore is crushed and screened to improve its physical characteristics, but ore known to be so improved is not included in the statistics as beneficiated ore because chemically, it is not improved. Of the direct-shipping ore, some is sintered later at consuming plants; this material is not considered beneficiated and is discussed in the Sinter section of this chapter.

Iron ore shipped from mines in the United States, 1925–29 (average), and 1942–46, in gross tons, and percentage of beneficiated ore compared to total shipped

[Exclusive of ore containing 5 percent or more manganese]

Year	Beneficiated	Total	Proportion of beneficiated to total (percent)	Year	Beneficiated	Total	Proportion of beneficiated to total (percent)
1925–29 (av.)	8,653,590	66,697,126	13.0	1944	20,303,422	94,544,635	21.5
1942	23,104,945	105,313,653	21.9	1945	19,586,782	87,580,942	22.4
1943	20,117,685	98,817,470	20.4	1946	15,588,763	69,494,052	22.4

In 1946, 16,321,744 gross tons of beneficiated ore were produced from 30,077,366 gross tons of crude ore. Beneficiation of iron ore was reported at 91 mines in 12 States in 1946, compared with 99 mines in 11 States in 1945. Beneficiated ore shipped from domestic mine plants in 1946 decreased 20 percent from 1945 and totaled 15,588,763 tons. Concentrates comprised 19 percent and sinter 4 percent of total usable ore shipments—unchanged from 1945.

The ratio of crude ore used to beneficiated ore produced was 1.843:1 in 1946, compared with 1.919:1 in 1945.

EMPLOYMENT

Complete data on employment in iron mines are not yet available. Preliminary figures indicate a 1-percent increase in the number of workers from 1945. The average number employed is estimated at 27,100 men working 48,480,000 man-hours to produce 71,289,283 tons of ore, an average of 1.47 tons per man-hour, or virtually unchanged from 1945. The above data and the table that follows include, in the Lake Superior district, manganiferous ore, which is treated by the trade as a special grade of iron ore.

Employment at iron-ore mines and beneficiating plants, quantity and tenor of ore produced, and average output per man in 1945, by districts and States [1]

District and State	Employment					Production									
		Time employed					Usable ore			Average per man (gross tons)					
				Man-hours				Iron contained		Crude ore		Usable ore			
	Average number of men employed	Average number of days	Total man-shifts	Average per shift	Total	Crude ore (gross tons)	Gross tons	Gross tons	Percent natural	Per shift	Per hour	Per shift	Per hour	Iron contained Per shift	Iron contained Per hour
Lake Superior: [1]															
Michigan	7,236	287	2,079,222	8.0	16,635,627	11,865,624	11,832,493	6,132,532	51.83	6.365	0.796	6.349	0.794	3.296	0.412
Wisconsin						1,368,215	1,368,215	720,552	52.66						
Minnesota	11,043	268	2,962,837	8.0	23,711,027	73,414,950	62,817,434	32,656,807	51.99	24.779	3.096	21.202	2.649	11.022	1.377
	18,279	276	5,042,059	8.0	40,346,654	86,648,789	76,018,142	39,509,891	51.97	17.185	2.148	15.077	1.884	7.836	.979
Southeastern States:															
Alabama	4,654	298	1,384,800	8.1	11,216,339	8,256,115	6,048,562	2,169,716	35.87	5.962	.736	4.368	.539	1.567	.193
Georgia	148	246	36,367	9.6	350,850	1,360,478	281,425	126,178	45.10	37.410	3.878	7.738	.802	3.470	.360
Virginia									31.50						
	4,802	296	1,421,167	8.1	11,567,189	9,616,593	6,329,987	2,295,894	36.27	6.767	.831	4.454	.547	1.615	.198
Northeastern States:															
New Jersey	560	305	170,606	8.0	1,364,859	855,470	430,308	273,578	63.58	5.014	.627	2.522	.315	1.604	.200
New York	2,453	308	754,302	8.0	6,071,262	6,830,868	3,189,839	1,963,706	63.82	9.056	1.125	4.229	.525	2.603	.323
Pennsylvania									56.40						
	3,013	307	924,908	8.0	7,436,121	7,686,338	3,620,147	2,237,284	61.80	8.310	1.034	3.914	.487	2.419	.301
Western States:															
California	115	228	26,182	9.2	240,701	280,573	208,609	116,278	55.74	10.716	1.166	7.968	.867	4.441	.483
Colorado						117	117	66	56.20						
New Mexico	134	178	23,792	8.1	193,811	369	369	221	60.00	19.993	2.454	9.326	1.145	4.347	.534
South Dakota						4,162	4,162	1,665	40.00						
Texas						471,014	217,237	101,478	46.71						
Missouri						257,591	113,330	62,178	54.86						
Nevada	278	284	79,046	8.5	669,080	6,196	6,196	3,974	64.14	11.004	1.300	9.179	1.084	4.793	.566
Wyoming						606,005	606,005	312,699	51.86						
Utah	156	281	43,769	7.9	345,610	1,931,749	1,931,749	1,020,700	52.84	44.135	5.589	44.135	5.589	23.320	2.953
	683	253	172,789	8.4	1,449,202	3,557,776	3,087,774	1,619,259	52.44	20.590	2.455	17.870	2.131	9.371	1.117
Total 1945	26,777	282	7,560,923	8.0	60,799,166	107,509,496	89,056,050	45,662,328	51.27	14.219	1.768	11.778	1.465	6.039	.751

[1] Includes manganese-bearing ore from the Lake Superior district; in 1945, all was from Minnesota.

WORLD REVIEW

Argentina.—The General Administration of Military Factories has completed a second phase of geological studies to determine the potentialities of the sedementary iron deposits that were discovered in the Province of Jujuy and that extend into the Province of Salta for a total length of 80 kilometers. Another survey recently has been made in Puesto Viejo, and ore reserves based upon these surveys, together with those that had been proven previously in the Cerro de Zapla anticline, raised the total reserve estimate to over 100,000,000 tons, which is believed sufficient to support a considerably expanded Argentine steel industry.

World production of iron ore, 1940–46, by countries, in metric tons [1]

[Compiled by P. Roberts]

Country [1]	1940	1941	1942	1943	1944	1945	1946
North America:							
Canada	376,120	468,138	494,691	581,769	501,899	1,030,052	1,434,309
Cuba	160,339	192,851	132,847	47,113	28,370		
Mexico	110,783	152,600	160,286	252,437	301,550	282,524	275,445
Newfoundland	1,532,990	983,259	1,212,016	551,515	471,824	1,000,449	1,264,141
United States	74,878,718	93,892,753	107,219,890	102,872,863	95,628,294	89,794,834	71,980,145
South America:							
Argentina	2,500	3,750	890	150	1,921		
Brazil	[2] 552,462	[2] 754,828	641,900	[3] 322,802	769,497	716,000	[2] 1,000,000
Chile [4]	1,749,840	1,702,692	408,587	299,411	674,529	944,863	1,352,886
Europe:							
Austria	3,186,139	2,895,025	2,996,912	3,188,459	3,014,909	323,488	462,016
Belgium	80,450	131,790	113,300	127,890	(5)	29,300	(5)
Bulgaria	30,000	(5)	(5)	(5)	(5)	(5)	(5)
Czechoslovakia	[6] 1,574,000	[6] 1,687,000	[6] 1,575,000	[7] 498,093	[7] 483,974	(5)	(5)
Finland	494,310	576,400	(5)	50,830	500,170	441,280	(5)
France	12,731,070	10,570,450	12,757,620	16,879,160	9,371,755	7,694,000	16,214,000
Germany [8]	16,208,989	15,455,698	13,223,456	(5)	(5)	(5)	(5)
Greece	[3] 26,477						
Hungary [9]	649,120	788,900	837,680	837,640	[10] 427,660	[11] 35,580	132,970
Italy	1,179,422	1,340,410	1,060,167	[10] 502,000	(5)	49,256	131,617
Luxembourg	4,887,042	6,829,584	5,110,050	5,253,025	2,912,500	1,495,877	2,246,908
Norway	615,448	566,513	284,498	219,000	264,426	78,538	94,500
Poland	(5)	(5)	(5)	(5)	(5)	(5)	387,006
Portugal	301	287	18		(5)	71,806	132,290
Rumania	150,484	166,349	215,250	244,457	(5)	(5)	(5)
Spain	2,012,238	1,718,979	1,606,161	1,587,817	1,508,610	1,171,377	[12] 2,383,552
Sweden	11,294,998	10,527,889	9,727,250	10,819,997	7,253,359	3,929,662	(5)
Switzerland	200,000	313,803	316,767	285,798	214,500	18,860	18,000
U. S. S. R. [13]	27,500,000	22,742,110	(5)	(5)	(5)	[3] 18,000,000	(5)
United Kingdom:							
Great Britain [14]	17,985,914	19,278,736	20,225,085	18,790,524	15,720,021	14,351,043	12,401,367
Northern Ireland	(5)	(5)	4,825	6,660	579	(5)	(5)
Yugoslavia	[2 15] 553,926	[2 15] 523,000	(5)	(5)	(5)	(5)	(5)
Asia:							
China	7,171,594	11,028,035	17,633,149	(5)	(5)	1,441,325	15,310
India	3,153,165	3,245,749	3,269,070	[2] 2,697,813	2,401,576	2,300,454	(5)
Indochina, French	32,442	52,250	63,000	82,000	29,700	7,920	(5)
Japan [16]	[17] 1,228,779	[17] 1,614,011	[17] 2,532,108	[17] 3,057,177	[17] 4,367,879	[17] 1,356,260	540,018
Korea (Chosen)	1,072,000	1,691,000	2,278,000	2,359,000	3,387,000	(5)	(5)
Malay States:							
Federated	972	726	} 92,233	49,137	10,621	13,590	(5)
Unfederated	1,872,903	(5)					
Philippines, Republic of	1,247,896	[18] 849,006	(5)	(5)	(5)	(5)	
Turkey	130,338	60,793	19,044	86,393	90,430	125,261	121,548
U. S. S. R.	(13)	(13)	(5)	(5)	(5)	(13)	(5)
Africa:							
Algeria	1,609,740	328,700	329,000	183,572	783,900	1,202,648	1,671,244
Belgian Congo	6,100	13,000	9,000	23,964			
Morocco:							
French	80,330	3,714	3,329	10,670	6,600	98	125,249
Spanish	614,371	554,776	547,432	547,625	690,880	764,816	(12)
Northern Rhodesia	271	271	394	624	212	76	162
Sierra Leone	(5)	[3] 1,046,501	[3] 643,241	517,727	641,165	(5)	(5)
Tunisia	343,562	912	30,994	29,703	88,863	132,450	183,705
Union of South Africa	638,757	812,700	717,738	738,128	768,392	866,188	(5)

See footnotes at end of table.

World production of iron ore, 1940–46, by countries, in metric tons [1]—Continued

Country [1]	1940	1941	1942	1943	1944	1945	1946
Oceania:							
Australia:							
New South Wales		64,115	185,041	205,691	154,326	47,358	(5)
Queensland	2,887	2,349	3,815	3,095	3,474	(5)	(5)
South Australia	2,350,484	2,276,345	2,156,111	2,217,865	2,061,810	1,543,983	1,847,398
Tasmania	1,186	2,215		7			5
Western Australia	(5)	(5)	4,825	6,660	579	(5)	(5)
New Caledonia	176,600	99,181		36,280	60,406		(5)
New Zealand	1,208	1,569	2,472	5,068	6,133	6,164	7,525
Total [10]	203,600,000	218,200,000	232,000,000	238,000,000	206,000,000	160,000,000	146,000,000

[1] In addition to the countries listed Burma, Egypt, Eritrea, French West Africa, Madagascar, and South-West Africa report production of iron ore, but quantity produced is believed insufficient to affect estimate of world total.
[2] Estimate.
[3] Exports.
[4] Production of Tofo mines.
[5] Data not available; estimate included in total.
[6] Bohemia, Moravia, and Slovakia.
[7] Bohemia and Moravia only.
[8] Exclusive of manganiferous iron ore carrying 12 to 30 percent manganese.
[9] Includes Northern Territories and Sub-Carpathia; in addition, beginning in 1941 includes Eastern Hungary and Transylvania; and beginning in 1942 includes Southern Territories.
[10] January to June, inclusive.
[11] June to December, inclusive.
[12] Spanish Morocco included with Spain.
[13] U. S. S. R. in Asia included with U. S. S. R. in Europe.
[14] Exclusive of bog ore, which is used mainly for purification of gas.
[15] Croatia only.
[16] Preliminary data for fiscal year ended March 31 of year following that stated.
[17] Includes iron sand production as follows: 1940–41, 134,000 tons; 1941–42, 233,000 tons; 1942–43, 368,000 tons; 1943–44, 427,000 tons; 1944–45, 858,782 tons; 1945–46, 235,094 tons.
[18] January to October, inclusive.
[19] Estimated by author of chapter.

Brazil.—The Hanna Exploration Co., a subsidiary of the M. A. Hanna Co. of Cleveland, Ohio, has disclosed plans for exploring iron-ore outcrops in the Brazilian Territory of Amata, north of the Amazon River, with a view to making the ore available to world markets.[4] It is indicated that the Amata deposits may be mined by open-pit methods and can be delivered to deep water with a relatively short rail haul.

Canada.—Mines producing iron ore in Canada during 1946 were the Helen, Victoria, and Josephine in the Michipicoten district and the Steep Rock on the Atikokan range. The Josephine mine was put into operation in 1946 and shipped 27,945 gross tons of lump ore and 97,010 tons of jigged concentrates. In the middle of October, all operations at the Josephine mine were closed down following a cave-in in the mine. Exploration was in progress in the Algoma area during 1946.[5]

Cuba.—Cuba re-entered the trade for United States imports of iron ore in 1946 after having been inactive for several years owing to shortages of shipping space. The iron ore mined during the year came chiefly from the Daiquiri mine in the Province of the same name, but a substantial tonnage came from the Estancia mine in Juragua. A small output of experimental Mayari ore was reported during the year.

[4] Skilling's Mining Review, Hanna Starts Iron Ore Exploration in Brazil: Vol. 35, No. 8, June 8, 1946, p. 9.
[5] Steel, New Canadian Ore Deposit has High Iron Content: Feb. 25, 1946, p. 102.

Iron ore shipped from mines in the Province of Oriente, Cuba, 1884–1946 in gross tons

	Juragua, Daiquiri, and Estancia (hematite and magnetite)	Sigua (hematite)	Mayari (brown ore)	Guama (hematite)	El Cuero (hematite)	Total
1884–1944	22,503,074	20,438	3,988,790	41,241	903,103	27,456,646
1945			302			302
1946	148,480		848			149,328
	22,651,554	20,438	3,989,940	41,241	903,103	27,606,276

Germany.—The opening of the first iron mine in the Bremen Consular District between Damme and Holdorf in Oldenberg was announced late in 1946. The ore in these deposits is 260 meters below the surface, and the beds range in thickness from 1 to 6 meters. The Damme mine is beginning operations with 100 workers, but plans call for an eventual employment of 1,500 and an output of 4,000 tons per day.

Italy.[6]—The total estimated reserves of iron ore in Italy amounts to 33,000,000 tons, but the cost of producing Piedmont iron carbonate ore and Tyrrhenian shore magnetic sand is prohibitive. These deposits must be considered only as a possible emergency supply and eliminated from the reserves available to industry. The following table shows the iron-ore reserves of the various districts of Italy.

Iron-ore reserves of Italy

Location	Metric tons	Approximate percent iron	Remarks
Island of Elba	[1] 6,000,000	50	Hematite, less than 1 percent Mn.
Island of Sardinia	[2] 7,000,000	50	Hematite and oolitic ironstone less than 1 percent Mn.
Piedmont	[1] 5,000,000	52	Magnetite, 40 percent Fe as mined.
Lombardy	[2] 13,000,000	50	Siderite, before calcining 42 percent Fe, 2 to 5 percent Mn.
Tyrrhenian shore	[3] 2,000,000	100	Concentrated from magnetic sand containing 6 to 15 percent iron when mined.
	33,000,000		

[1] Positive.
[2] Indicated.
[3] Inferred, in terms of metallic iron.

Mexico.—A description of the iron-ore deposits in Mexico has been published recently; the total reserves were given as 212,550,000 metric tons.[7]

Newfoundland.—The No. 2 mine on Bell Island was opened in May, and there were then four Wabana mines being worked; it had been 4 years since as many mines were in operation. The average force

[6] Botsford, C. A., American Embassy, Rome, report of June 6, 1946.
[7] Inter-American Development Commission, Washington, D. C., The Coal and Iron Deposits of Mexico Undated, 30 pp.

working in 1946 was 2,000 men, and the average output was 5,700 tons of ore per day. Ore from these mines was being shipped to Canada, United Kingdom, and United States.

Norway.—At the close of 1946, construction was under way at a Government-owned iron and steel works at Mo i Rarna. Iron ore for the plant will come from mines in the far north and southern Norway. At a later period it is planned to utilize ore occurring around Mo, where it is estimated there are approximately 1,000,000,000 tons of available reserves. Pig iron-ore furnaces will be the largest electric furnaces in the world and will be designed for 24,000 kva., although immediate plans are to use only 18,000 kva. The largest electric pig-iron furnaces previously built were 13,000 kva.[8]

Sweden.—It was announced late in August 1946 that the Bethlehem Steel Corp. had arranged a contract for the purchase of 1,000,000 tons of Swedish iron ore.[9] Imports from Sweden totaled 232,887 gross tons by the close of 1946.

Union of South Africa.—C. J. N. Jourdan of Iscor has estimated reserves of iron ore in the Union of South Africa at 122,000,000 tons of high-grade ore, 5,900,000,000 of medium-grade, 2,140,000,000 of titaniferous ore, and 2,286,000,000,000 tons of low-grade potential ore.[10]

[8] The Iron Age, European Letter: Vol. 158, No. 26, Dec. 26, 1946, p. 86-87.
[9] American Metal Market, Bethlehem Contract for Large Purchase Swedish Iron Ore: Aug. 30, 1946.
[10] The South African Mining and Engineering Journal, The Union's Huge Iron Ore Reserves Sufficient to Last for Many Years: Vol. 57, Pt. 1, No. 2791, Aug. 10, 1946, pp. 599-601.

Iron and Steel[1]

By NORWOOD B. MELCHER

GENERAL SUMMARY

THE IRON and steel industry in 1946 experienced sharp declines in operating rates, especially in the first half, largely as a result of strikes in this and allied industries. A general steel strike, which was called January 14, 1946, and continued for approximately 1 month, reduced steel operations to the lowest point in the history of the industry and production to the lowest level in 53 years. In April, a strike by soft-coal miners resulted in a loss for the period of more than 750,000 tons of steel ingots during April and 2 million in May. A second work stoppage in soft-coal mines, beginning November 21 and continuing until December 9, decreased further the production of iron and steel during 1946.

Steel supplies grew increasingly short throughout 1946, as reconversion to the manufacture of civilian products proceeded after the war. The production of consumer durables by the latter half of the year approached and, in many instances, exceeded the prewar output. The automobile industry, in producing 2,154,924 passenger cars and 940,282 trucks, reached 50 and 89 percent, respectively, of the 1941 output. This industry used 13 percent of the total delivered steel products during 1946 and was second to the construction industry in tonnage used. Production of automobiles was retarded early in the year by strikes and was continuously handicapped by lack of steel products, especially sheet and strip, which were in heavy demand by the container and construction industries. Sheet and strip comprised 29 percent of the total steel output during 1946 and were rolled at a rate virtually equal to that of 1940. The production rate of the automobile industry during the fourth quarter of the year had established a postwar peak but was considerably below that of the record year 1929. The construction industry, although considerably less active than during the war years, used proportionately more steel. Seventeen percent of total steel products was shipped for construction and maintenance during 1946, compared with 15 percent in 1945 and 16 percent in 1939. The value of new construction in 1946 exceeded 10 billion dollars, or more than double that of 1945 and only about 25 percent below the record set in 1942. The housing shortage grew more acute throughout the year and resulted in the passage by Congress, in May, of the Veterans' Emergency Housing Act, which grants priority for the building of homes for sale or rent to veterans and imposes a $10,000 ceiling on new single-family residences. Under the authority of the Second War Powers Act, a housing expediter

[1] The chapter formerly designated "Pig Iron, Ferro-Alloys, and Steel" is separated in this volume into the present Iron and Steel chapter and a Ferro-Alloys chapter.

(appointed in January) announced a program to provide 2,700,000 housing units in the succeeding 2-year period; subsidy payments rather than price increases were used to stimulate production of building materials wherever possible. Because construction already begun before the effective date of restrictive regulations was permitted to continue, the value of private nonresidential building continued to rise throughout the year to a total of 4.5 billion dollars. Public and private residential building in 1946, although making large gains, totaled nearly a billion dollars less than nonresidential building for the year. At the end of the year, the construction industry was looking forward to completing 1 million privately financed residences during 1947.

Railroads consumed less tonnage in 1946 than during the previous year but used a greater percentage of the total than during any period since 1939, and the relative use was unchanged from 1945. The railroads' freight load approximated 632 billion net ton miles in 1946—a decline of 13 percent from the 1945 total. Deliveries of new freight and passenger cars totaled 49,905 and 1,364 units, respectively, during 1946. Shipbuilding became a minor consumer of steel products in 1946 and used only 290,000 tons, compared to over 3 million in 1945, and an average of nearly 10 million tons per year from 1941 to 1944, and was at a rate about half that of 1939. Shipments of steel to the agricultural industry and for export reverted to the prewar level, accounting for 3.5 percent and 6.3 percent, respectively, of the total. Deliveries of steel products to the machine-tool industry totaled 3,637,000 tons, which was more than 50 percent greater than the prewar year of 1940.

Salient statistics of iron and steel in the United States, 1942–46, in net tons

	1942	1943	1944	1945	1946
Pig iron:					
Production	59,077,593	60,765,195	61,003,759	53,224,213	44,842,025
Shipments	59,100,601	60,787,159	60,995,977	53,265,353	45,075,890
Imports		1,445	5,778	21,433	14,091
Exports	110,647	144,269	162,478	90,968	95,698
Steel:[1]					
Production of ingots and castings:					
Open-hearth:					
Basic	75,183,065	77,207,870	79,168,294	71,069,876	60,112,300
Acid	1,318,892	1,413,934	1,195,659	869,726	599,663
Bessemer	5,553,424	5,625,492	5,039,923	4,305,318	3,327,737
Crucible	2,010	146	25	24	2,563,024
Electric	3,974,540	4,589,070	4,237,699	3,456,704	
	86,031,931	88,836,512	89,641,600	79,701,648	66,602,724
Capacity, annual	88,966,680	90,636,490	93,564,560	95,505,280	91,890,560
Percent of capacity	96.7	98.0	95.8	83.5	72.5
Production of alloy steel:					
Stainless	340,780	457,448	477,498	542,904	542,710
Other than stainless	11,185,594	12,692,370	10,155,588	8,104,807	5,534,985
	11,526,374	13,149,818	10,633,086	8,647,711	6,077,695
Shipments of steel products:					
For domestic consumption	52,792,616	54,288,793	59,287,961	53,448,897	45,748,761
For export	7,672,158	5,616,853	4,925,198	3,793,343	3,026,771
	60,464,774	59,905,646	64,193,159	57,242,240	48,775,532

[1] American Iron and Steel Institute. Capacity figures Dec. 31 from A. I. S. I. Form 7.

During 1946, there were several amendments to Order M–21 pertaining to pig iron and steel. Directive 12, issued June 12, provided for certified orders for steel needed during the third quarter of 1946 to make products for highly critical programs, veterans' housing, and certain farm equipment. This directive covered ingots, shapes, tubing, sheet and strip, castings and forgings (rough), wheels, tires, axles, wire rod, and wire accessories. Directive 13, effective July 9, required certified orders for merchant pig iron and iron castings for veteran-housing and certain farm-machinery programs; minor modifications of this order were made effective August 1. Because of shortages in pig-iron production, an amendment to Directive 13, effective August 9, ordered that authorizations to purchase merchant pig iron in the southern area for the production of cast-iron pressure pipe be reduced 25 percent and for all other products (except cast-iron soil pipe) 10 percent, and certain furnaces in Pittsburgh, Buffalo, and eastern Pennsylvania that had received a disproportionate share of certified orders were directed to reduce each such order for August delivery by 10 percent. A September 6 amendment to Directive 13 reassigned assistance in obtaining iron castings to Priorities Regulation 28 and provided for continued allocation of merchant pig iron during the fourth quarter.

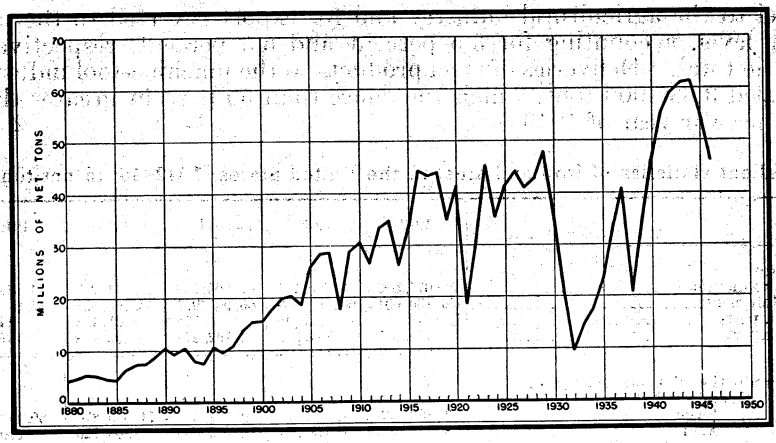

FIGURE 1.—Trend in production of pig iron in the United States, 1880–1946.

The production of pig iron decreased 16 percent in 1946 from 1945 entirely as a result of the drop in steel production. Thus, the decline in pig-iron output was mainly of the basic and Bessemer grades, which constitute most of the pig iron used in steel making. Foundry pig iron, used in making iron castings, increased 17 percent over 1945, and malleable production continued at approximately the 1945 rate. The pig-iron supply was generally tight during 1946, especially in the foundry and malleable grades, which were required for the housing program and upon which premium payments were made by the Government after August 31, 1946. The premium-payment plan announced by housing expediter Wilson W. Wyatt under the Veterans' Housing Act of 1946 called for payment by the Government of

$8 per gross ton for production above base-period quotas by operating furnaces and $12 per ton for production from plants that would be reopened. Payments were made on shipments on and after September 1, and the plan was scheduled to end June 30, 1947. Base period for determining quotas was January 1 to August 31, 1946. Price control on iron and steel and their products terminated November 10, 1946, when all price controls except those on sugar and rice were eliminated by order of Paul A. Porter, Price Administrator.

Both wages and prices increased throughout the steel industry during 1946. The average hours worked per week, based upon the 40-hour week, varied only slightly and averaged 38.7 hours at the close of the year. Average weekly earnings for this group, including workers at blast furnaces, steel works, and rolling mills, which amounted to $47.33 in December 1945, had increased to $50.72 a year later. The composite price of finished steel, as given by Iron Age, increased from 2.44104 cents per pound on December 31, 1945, to 2.83599 cents per pound on December 31, 1946. The composite price of pig iron increased from $25.37 to $30.14 per gross ton, and steel scrap had increased from $19.17 per gross ton to $31.17.

PRODUCTION AND SHIPMENTS OF PIG IRON

Domestic production of pig iron, exclusive of ferro-alloys, decreased 16 percent from 1945 and totaled 44,842,025 net tons, of which 44,809,893 tons were made using coke and 32,132 tons using charcoal as a fuel. Pennsylvania was the largest producer of pig iron in 1946, with 30 percent of the total; Ohio ranked next with 21 percent. Of the pig iron manufactured in 1946, it is calculated that 1,072,574 tons, valued at $27,451,968, were made from 1,822,838 tons of foreign ore from Africa, Canada, Chile, Cuba, Mexico, Newfoundland, and

Pig iron produced and shipped in the United States, 1945–46, by States

State	Produced		Shipped from furnaces			
	1945	1946	1945		1946	
	Net tons	Net tons	Net tons	Value	Net tons	Value
Alabama	3,581,993	3,135,387	3,588,863	$65,991,229	3,145,303	$66,517,978
California	327,244	323,925	313,883		344,024	
Colorado	1,314,081	1,055,991	1,279,153	31,051,220		30,578,847
Utah					1,095,238	
Illinois	5,045,609	4,357,310	5,061,368	116,303,897	4,359,719	109,717,853
Indiana	5,981,717	4,828,528	5,981,937	138,253,310	4,823,257	122,786,881
Kentucky	631,105	624,174	631,105	(1)	624,174	(1)
Maryland	2,246,941	1,945,006	2,244,964	(1)	1,945,852	(1)
Massachusetts		8,730	(1)	(1)	9,878	(1)
Michigan	1,454,131	1,345,575	1,482,037	26,079,628	1,363,950	37,081,447
Minnesota	466,758	531,356	465,314	(1)	540,057	(1)
New York	3,294,724	2,771,006	3,278,345	74,857,092	2,801,828	63,937,403
Ohio	11,258,960	9,628,101	11,264,024	258,959,815	9,647,981	240,218,956
Pennsylvania	16,172,296	13,251,337	16,168,496	361,684,919	13,330,186	329,194,957
Tennessee	(1)	32,132	(1)	(1)	32,688	(1)
Texas	(1)		147,247	(1)		
Virginia			(1)	(1)	2	(1)
West Virginia	1,272,148	1,003,467	1,265,346	(1)	1,011,753	
Undistributed [1]	176,506		93,271	99,254,055		103,894,664
	53,224,213	44,842,025	53,265,353	1,172,435,165	45,075,890	1,103,928,986

[1] Data that may not be shown separately are combined as "Undistributed."

Sweden, indicating an average yield of 58.84 percent from foreign ore. Domestic ore (66,761,043 tons) and sinter (11,837,506 tons) and 6,809,241 tons of miscellaneous materials were reported as used in the manufacture of 43,769,451 tons of pig iron, indicating an average pig-iron yield of 51.25 percent from domestic materials. In addition, 1,168,590 tons of home scrap and 74,803 tons of flue dust were consumed in making pig iron in 1946.

Shipments of pig iron decreased 15 percent in quantity from 1945, but only 6 percent in value. The values given in the accompanying table represent the approximate amounts received for the iron f. o. b. furnaces and do not include freight cost, selling commissions, and other items normally included in market prices for pig iron as published by trade journals.

Pig iron shipped from blast furnaces in the United States, 1945–46, by grades

Grade	1945			1946		
	Net tons	Value		Net tons	Value	
		Total	Average		Total	Average
Charcoal	52,263	(1)	(1)	32,688	(1)	(1)
Foundry	2,238,013	$46,296,846	$20.69	2,615,223	$61,025,123	$23.33
Basic	40,332,690	873,657,477	21.66	34,131,539	827,680,207	24.25
Bessemer	7,735,489	180,911,470	23.39	5,682,079	147,753,446	26.00
Low-phosphorus	307,792	8,697,437	28.26	182,139	5,133,543	28.18
Malleable	2,356,250	55,798,845	23.68	2,226,843	56,210,006	25.24
All other (not ferro-alloys)	242,856	7,073,090	29.97	205,379	6,126,661	25.74
	53,265,353	1,172,435,165	22.01	45,075,890	1,103,928,986	24.49

1 Value included with "All other."

Blast furnaces (including ferro-alloy blast furnaces) in the United States, 1945–46

[American Iron and Steel Institute]

State	Dec. 31, 1945			Dec. 31, 1946		
	In blast	Out of blast	Total	In blast	Out of blast	Total
Alabama	17	3	20	19	1	20
California	1		1	1		1
Colorado	3	1	4	4		4
Illinois	18	4	22	20	1	21
Indiana	18	2	20	18	2	20
Kentucky	3		3	3		3
Maryland	6	1	7	7		7
Massachusetts		1	1	1		1
Michigan	5		5	5		5
Minnesota	2	1	3	3		3
New York	13	4	17	13	3	16
Ohio	42	5	47	44	2	46
Pennsylvania	65	11	76	70	2	72
Tennessee	2	1	3	2	1	3
Texas		2	2		2	2
Utah	2	3	5	3	1	4
Virginia		1	1	1		1
West Virginia	4		4	4		4
	201	40	241	218	15	233

Metalliferous Materials Used.—The production of pig iron in 1946 required 80,421,387 tons of iron ore, sinter, and manganiferous iron ore, 2,621,570 tons of mill cinder and roll scale, 3,043,713 tons of open-hearth and Bessemer slag, 1,104,348 tons of purchased scrap, 38,101 tons of miscellaneous materials, an average of 1.945 tons of metalliferous materials (exclusive of home scrap and flue dust) per ton of pig iron made.

Alabama furnaces used red hematite from Jefferson County, Ala., and brown ore from Alabama, Georgia, and Texas. Manganese-bearing ores of domestic and Mexican origin and pyrite cinder from Virginia also were used. Because of the preponderance of relatively low-grade ore used in the Alabama furnaces, the consumption of ore per ton of pig iron is higher than in any other State.

The iron ore used at Fontana, Calif., furnaces came from the Vulcan mine in San Bernardino County, Calif., and the Walker Iron Mining Co. mine in Iron County, Utah. Some of the iron ore was sintered at Fontana before using. Manganese ore from Lower California, Mexico, was also used.

The blast furnaces at Pueblo, Colo., used hematite from the Sunrise mine in Platte County, Wyo., and the Duncan mine in Iron County, Utah. The manganiferous ore used came from the Boston Hill mine, Grant County, N. Mex.

The blast furnaces at Sparrows Point, Md., used Lake Superior ore and foreign ore from Africa, Chile, Cuba, and Sweden. Domestic manganiferous ore from the Lake Superior district and foreign ore from Africa also were used.

Blast furnaces in Illinois, Indiana, and Kentucky used Lake Superior iron ore and manganiferous iron ore exclusively. Furnaces in Michigan, Minnesota, and West Virginia used mostly Lake Superior ore, but a considerable tonnage from Canada also was used.

In New York, the furnaces in the Buffalo district used hematite from the Lake Superior district and Canada and magnetite from New York. The furnace at Troy consumed magnetite from the Chateaugay mine at Lyon Mountain, N. Y.

Ohio blast furnaces consumed magnetite sinter from New York and domestic and Canadian hematite from the Lake Superior district.

Virtually all of the ore consumed in western Pennsylvania furnaces came from the Lake Superior district. Furnaces in the eastern part of the State used some Lake ore, some magnetite ore from New Jersey, New York, and Pennsylvania, and ore from Africa.

Utah furnaces used semialtered magnetite from the Iron Mountain mine near Cedar City, Utah, and manganese-bearing ores from Nevada and Utah. The sinter used was produced at Geneva and Provo from Iron Mountain fine ore.

The blast furnace at Everett, Mass., used hematite from the Lake Superior district, magnetite from New Jersey, and foreign iron ore from Algeria and Newfoundland.

Iron ore and other metallic materials consumed and pig iron produced, 1945–46, by States, in net tons

State	Metalliferous materials consumed: Iron and manganiferous iron ores: Domestic	Iron and manganiferous iron ores: Foreign	Sinter	Miscellaneous	Total	Pig iron produced	Materials consumed per ton of pig iron made: Ores	Sinter	Miscellaneous	Total
1945										
Alabama	6,673,324	4,206	1,801,589	197,897	8,677,016	3,581,993	1.864	0.503	0.055	2.422
California	361,568	7,349	209,272	55,801	633,990	327,244	1.127	.639	.171	1.937
Colorado, Utah	1,657,112		697,609	64,781	2,419,502	1,314,081	1.261	.531	.049	1.841
Illinois	8,736,849		688,426	756,688	10,181,963	5,045,609	1.732	.136	.150	2.018
Indiana	10,348,308		917,062	866,061	12,131,431	5,981,717	1.730	.153	.145	2.028
Kentucky	1,016,140		42,609	169,239	1,227,988	631,105	1.610	.068	.268	1.946
Maryland	2,753,375	67,264	754,583	678,903	4,254,125	2,246,941	1.255	.336	.302	1.893
Michigan	2,504,060		261,663	93,972	2,859,695	1,454,131	1.722	.180	.065	1.967
Minnesota	832,643		1,383	86,801	920,827	466,758	1.784	.003	.186	1.973
New York	5,320,334	36,123	673,963	356,677	6,387,097	3,294,724	1.626	.205	.108	1.939
Ohio	15,366,511	57,792	3,869,945	1,942,654	21,236,902	11,258,960	1.370	.344	.172	1.886
Pennsylvania	22,938,574	20,614	4,010,518	3,358,140	30,327,846	16,172,296	1.420	.248	.207	1.875
Tennessee, Texas	235,324	62,621	44,128	5,743	347,816	176,806	1.688	.250	.083	1.971
West Virginia	1,990,100	82,045	83,562	157,122	2,312,829	1,272,148	1.629	.066	.123	1.818
	80,734,222	338,014	14,056,312	8,790,479	103,919,027	53,224,213	1.523	.264	.165	1.952
1946										
Alabama	5,897,958	3,338	1,609,262	139,658	7,650,216	3,135,387	1.882	.513	.045	2.440
California	343,091	4,182	209,942	53,772	610,987	323,925	1.072	.648	.166	1.886
Colorado, Utah	1,456,261		446,652	41,688	1,944,601	1,055,991	1.379	.423	.039	1.841
Illinois	7,446,679		603,459	633,815	8,683,953	4,357,310	1.709	.139	.145	1.993
Indiana	8,315,584		719,575	655,153	9,681,312	4,828,528	1.722	.147	.136	2.005
Kentucky	1,042,405		22,954	150,477	1,215,836	624,174	1.670	.037	.241	1.948
Maryland	1,398,458	1,299,412	360,936	464,934	3,523,740	1,945,006	1.387	.186	.239	1.812
Massachusetts	12,278	3,606		694	16,578	8,730	1.819		.080	1.899
Michigan	2,074,248	95,350	264,955	137,115	2,571,668	1,345,575	1.612	.197	.102	1.911
Minnesota	993,606	61		58,854	1,052,521	531,356	1.870		.111	1.981
New York	4,227,001	40,721	776,435	370,681	5,414,838	2,771,006	1.540	.280	.134	1.954
Ohio	12,830,219	229,316	3,340,723	1,559,737	17,959,995	9,628,101	1.356	.347	.162	1.865
Pennsylvania	19,131,826	38,024	3,379,014	2,425,410	24,974,274	13,251,337	1.447	.255	.183	1.885
Tennessee, West Virginia	1,591,529	108,828	112,599	115,744	1,928,700	32,132 1,003,467	1.642	.109	.115	1.862
	66,761,043	1,822,838	11,837,506	6,807,732	87,229,119	44,842,025	1.529	.264	.152	1.945

[1] Excludes recycled materials.

Foreign iron and manganiferous iron ore consumed in the manufacture of pig iron in the United States, 1945–46, by sources of ore, in net tons

Source	1945	1946	Source	1945	1946
Africa	83,926	139,369	Newfoundland		3,158
Canada	57,792	472,628	Sweden		91,041
Chile	3,284	1,033,492	Unclassified	116,164	
Cuba	2,672	75,630			
Mexico	74,176	7,520	Total	338,014	1,822,838

PRODUCTION OF STEEL

Steel production decreased 16 percent from 1945, and capacity decreased 4 percent. The drop in steel-making capacity was due to the dismantling of obsolete equipment used during the war when maximum steel production was required. Capacity at the end of 1946 totaled 91,890,560 short tons, compared with the record high of

95,505,280 at the end of 1945. Production of steel ingots and castings in the United States in 1946 was 66,602,724 tons. Of this total, 91.2 percent was made in open-hearth furnaces, 5.0 percent in Bessemer converters, and 3.8 in electric furnaces. Included in the last figure is a small production of steel in crucible furnaces, which is not available separately for 1946. In 1946, 90.9 percent of domestic steel output was made in furnaces in the Northeastern district, 4.6 percent in the Southern district, and 4.5 percent in the Western district, compared with 91, 4.6, and 4.4 percent, respectively, in 1945.

The data concerning steel production used by the Bureau of Mines are furnished by the American Iron and Steel Institute. The output from steel foundries that do not produce steel ingots is not included in the statistics.

Steel capacity, production, and percent of operations, 1942–46, in net tons [1]

[American Iron and Steel Institute]

Year	Annual capacity [2] as of Dec. 31	Production					
		Open hearth	Bessemer	Crucible	Electric and all other	Total	Percent of capacity
1942	88,956,680	76,501,957	5,553,424	2,010	3,974,540	86,031,931	96.7
1943	90,636,490	78,621,804	5,625,492	146	4,589,070	88,836,512	98.0
1944	93,564,560	80,363,953	5,039,923	25	4,237,699	89,641,600	95.8
1945	95,505,280	71,939,602	4,305,318	24	3,456,704	79,701,648	83.5
1946	91,890,560	60,711,963	3,327,737	[3]	2,563,024	66,602,724	72.5

[1] The figures include only that portion of the capacity and production of steel for castings used by foundries which were operated by companies producing steel ingots.
[2] Capacity figures from A. I. S. I. Form 7.
[3] Included with "Electric and all other."

Open-hearth steel ingots and castings manufactured in the United States, 1942–46, by States, in net tons [1]

[American Iron and Steel Institute]

State	1942	1943	1944	1945	1946
New England States	472,521	487,773	444,101	432,601	367,868
New York and New Jersey	4,378,808	4,488,951	4,365,108	3,813,333	3,242,138
Pennsylvania	23,562,866	24,548,335	24,677,513	21,194,721	17,495,219
Ohio	14,769,085	14,834,574	15,011,818	13,402,084	11,446,783
Indiana	10,578,989	10,679,645	10,925,049	10,237,621	8,359,305
Illinois	6,335,946	6,350,309	6,496,338	5,812,286	4,851,975
Other States	16,403,742	17,232,217	18,444,026	17,046,956	14,948,675
	76,501,957	78,621,804	80,363,953	71,939,602	60,711,963

[1] Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots.

Bessemer-steel ingots and castings manufactured in the United States, 1942–46, by States, in net tons [1]

[American Iron and Steel Institute]

State	1942	1943	1944	1945	1946
Ohio	2,250,717	2,365,326	2,207,176	1,930,956	1,447,825
Pennsylvania	1,997,547	1,926,316	1,645,247	1,388,284	1,143,388
Other States	1,305,160	1,333,850	1,187,500	986,078	736,524
	5,553,424	5,625,492	5,039,923	4,305,318	3,327,737

[1] Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots.

Steel electrically manufactured in the United States, 1942–46, in net tons [1]

[American Iron and Steel Institute]

Year	Ingots	Castings	Total	Year	Ingots	Castings	Total
1942	3,843,757	130,783	3,974,540	1945	3,381,678	75,026	3,456,704
1943	4,473,377	115,693	4,589,070	1946	2,479,064	83,960	[2] 2,563,024
1944	4,131,703	105,996	4,237,699				

[1] Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots.
[2] Includes crucible steel.

Alloy Steels.—The steel output for 1946 includes 6,077,695 net tons of alloy-steel ingots and castings, which represent 9 percent of the total, as compared to 11 percent in 1945. This figure includes steels in which the minimum of the range specified in one or more of the elements named exceeds the following percentages: Copper, 0.60 percent; manganese, 1.65 percent; and silicon, 0.60 percent; or steels containing aluminum, chromium, cobalt, columbium, molybdenum, nickel, titanium, tungsten, vanadium, zirconium, and other alloying elements when added to steel to obtain desired alloying effects. The output of alloy steels in 1946 decreased 30 percent from 1945, whereas total steel decreased only 16 percent. Of the alloy steel produced in 1946, 71 percent came from basic open-hearth, 2 percent from acid open-hearth, and 27 percent from electric furnaces and crucibles; none was produced in Bessemer converters.

From the accompanying tables it will be seen that most of the steel made in electric furnaces (64 percent in 1946) is alloy steel. Typically, steels with higher alloy content are made in electric furnaces and steel with lower content by the open-hearth process.

Alloy-steel ingots and castings manufactured in the United States, 1942–46, by processes, in net tons [1]

[American Iron and Steel Institute]

Process	1942	1943	1944	1945	1946
Open hearth:					
Basic	7,524,209	8,539,523	6,494,627	5,572,353	4,325,657
Acid	608,867	677,416	515,662	274,889	116,211
Crucible	522	136	23	18	1,635,827
Electric	3,392,776	3,932,743	3,622,774	2,800,451	
	11,526,374	13,149,818	10,633,086	8,647,711	6,077,695

[1] Includes only that portion of steel for castings produced in foundries operated by companies manufacturing steel ingots.

Metalliferous Materials Used.—During 1946, steel furnaces used 3,117,774 net tons of domestic iron ore and 446,611 tons of foreign ore, most of which came from Chile and Sweden, smaller quantities originating in Africa and Canada. In addition, open-hearth furnaces consumed 769,640 tons of sinter made from both foreign and domestic materials.

Both charge ore and feed ore are used in the basic open-hearth process. Charge ore is used to add oxygen to the charge before it is melted. This ore should be low in combined and uncombined moisture, silica, and fines. Ore with a high silica content requires large additions of limestone and consequently produces large volumes of slag, which reduces furnace efficiency. Iron-ore sinter has been found to be a good charge ore in open-hearth practices.

Feed ore, which is added to the heat during the working period, should be hard, dense, coarse, and low in moisture. Although moderately high-silica ore can be used as feed, it is undesirable, as in charge ore, because of the larger quantity of slag resulting. Lump ore, which is preferred as feed ore, is high-priced, and the supply is limited.

Metalliferous materials consumed in steel furnaces in the United States, 1943–46, in net tons

Year	Iron ore		Sinter	Manganese ore		Pig iron	Ferro-alloys	Iron and steel scrap	
	Domestic	Foreign		Domestic	Foreign			Home	Purchased
1943	4,574,277	46,939	1,490,361	6,064	27,985	53,759,354	1,828,000	29,088,371	18,420,700
1944	4,629,102	12,562	1,586,654	2,177	9,321	54,104,677	1,648,000	29,422,868	18,193,639
1945	3,793,562	24,465	1,291,929	1,915	7,245	46,596,855	1,388,000	25,236,910	17,919,602
1946	3,117,774	446,611	769,640	2,364	2,110	38,443,934	1,044,000	19,868,551	16,513,487

CONSUMPTION OF PIG IRON

Consumption of pig iron in 1946 decreased 15 percent from 1945. Pig iron, a product of the blast furnace, is a semiraw material and, except for a small quantity used in direct castings, moves to steel- or iron-melting furnaces, for further refining, alone or mixed with other ingredients. In 1946, 85 percent of the pig iron went to steel-making furnaces (open-hearth, Bessemer, and electric) to be processed into steel. Direct castings took 4 percent and the remaining 11 percent was consumed in iron-making furnaces, of which the cupola is the most important. Gray-iron foundries continued to use more pig iron in 1946. Consumption in cupolas increased 13 percent over 1945, whereas the use in all other important pig iron-consuming furnaces decreased during the year; cupolas used 10 percent of total pig iron in 1946, compared with 8 percent in 1945.

Consumption of pig iron in the United States, 1943–46, by type of furnace

Type of furnace or equipment	1943		1944		1945		1946	
	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total	Net tons	Percent of total
Open-hearth	47,107,608	78.1	48,281,168	79.2	41,682,581	78.4	34,608,053	76.8
Bessemer	6,257,927	10.4	5,583,027	9.2	4,750,817	8.9	3,722,756	8.3
Electric	393,819	.6	240,482	.4	163,457	.3	113,125	.3
Cupola [1]	3,602,918	6.0	3,941,159	6.5	4,084,091	7.7	4,612,704	10.2
Air	537,902	.9	499,457	.8	433,953	.8	356,436	.8
Brackelsberg								
Crucible	457	(2)	863	(2)	552	(2)	985	(2)
Puddling	38,231	.1	28,166	(2)	22,725	(2)	14,506	(2)
Direct castings [1]	2,376,297	3.9	2,377,299	3.9	2,049,001	3.9	1,641,874	3.6
Miscellaneous							1,191	(2)
	60,315,159	100.0	60,951,621	100.0	53,187,177	100.0	45,071,630	100.0

[1] Some pig iron used in making direct castings included in cupola.
[2] Less than 0.05 percent.

Plants using pig iron in 1946 were located in all 48 States and in the District of Columbia, but consumption is concentrated largely in the steel-making centers of the North Central, Middle Atlantic, and Southeastern States. These areas together, in 1946, used 96 percent of the pig iron, Pennsylvania (the leading consumer) taking 29 percent of the total and Ohio (the second largest consumer) 20 percent.

Consumption of pig iron in the United States, 1943–46, by States and districts

State and district	1943		1944		1945		1946	
	Consumers	Net tons	Consumers	Net tons	Consumers	Net tons	Consumers	Net tons
Connecticut	56	113,588	57	101,816	61	104,676	55	88,307
Maine	14	6,133	15	6,543	16	6,692	16	10,267
Massachusetts	103	225,465	104	192,870	103	184,432	94	154,654
New Hampshire	15	5,830	16	6,785	16	8,908	15	5,992
Rhode Island	12	46,756	12	39,858	12	38,670	10	28,339
Vermont	13	14,751	13	12,057	12	11,133	12	9,411
Total New England	213	412,523	217	359,929	220	354,511	202	296,970
Delaware	7	415,936	7	355,486	8	331,639	7	292,498
New Jersey	77		74		81		77	
New York	198	3,032,096	194	2,958,342	197	2,598,306	179	2,201,586
Pennsylvania	375	19,367,283	380	19,095,662	434	16,047,518	354	13,120,922
Total Middle Atlantic	657	22,815,315	655	22,409,490	720	18,977,463	617	15,615,006
Alabama	68	3,101,043	67	3,263,647	69	2,884,295	66	2,568,276
District of Columbia	1		1		3		1	
Kentucky	23	3,156,432	24	3,185,611	24	2,848,408	24	2,629,314
Maryland	21		22		26		21	
West Virginia	28	1,748,020	25	1,671,046	25	1,433,478	25	1,115,785
Florida	18	88,719	19	89,835	18	88,111	17	63,613
Georgia	45		49		52		52	
Mississippi	6	576	6	903	6	1,023	8	2,256
North Carolina	42	13,464	46	18,062	48	22,886	50	28,423
South Carolina	15	4,610	17	4,779	17	5,355	17	7,348
Tennessee	52	134,878	54	162,913	55	176,736	52	197,055
Virginia	51		49		53		53	
Total Southeastern	370	8,247,742	379	8,396,796	396	7,460,292	386	6,612,070
Arkansas	3		5		5		4	
Oklahoma	10	4,098	13	6,826	12	7,944	10	5,620
Louisiana	7		12		13		12	
Texas	40	23,715	45	152,058	42	174,497	37	54,138
Total South Central	60	27,813	75	158,884	72	182,441	63	59,758
Illinois	208	5,266,187	209	5,158,045	225	4,426,898	208	3,716,293
Indiana	126	7,218,967	131	7,453,187	142	6,543,439	126	5,356,288
Iowa	51	68,883	55	103,055	56	83,412	58	104,744
Minnesota	59	412,853	58	443,943	63	426,666	61	443,861
Missouri	53	123,124	59	130,537	56	106,734	52	93,298
Kansas	14	6,682	21	10,381	24	13,532	24	16,901
Nebraska	11		12		13		11	
Michigan	172	2,098,447	178	2,332,201	189	2,228,616	173	2,275,887
Wisconsin	112		110		122		115	
North Dakota	1	210	1	412	1	578	1	316
South Dakota	2		1		1		1	
Ohio	324	12,410,067	335	12,271,656	339	10,803,564	297	9,162,118
Total North Central	1,133	27,605,420	1,170	27,903,417	1,231	24,633,439	1,127	21,169,706
Arizona	2	81	3	91	4	133	5	1,022
Nevada								
New Mexico								
Colorado	16	721,672	20	1,082,544	28	1,067,032	26	761,468
Utah								
Idaho								
Wyoming	4	468	3	367	4	495	4	1,547
Montana								
Total Rocky Mountain	22	722,221	26	1,083,002	36	1,067,660	35	764,037
Oregon	21	35,699	33	39,614	31	34,834	32	33,795
Washington	38		37		40		31	
California	114	448,426	128	600,489	137	476,537	123	520,288
Total Pacific Coast	173	484,125	198	640,103	208	511,371	186	554,083
Total United States	2,628	60,315,159	2,720	60,951,621	2,883	53,187,177	2,616	45,071,630

PRICES

The average value of all grades of pig iron given in the accompanying table is compiled from reports of producers to the Bureau of Mines. The figures represent value f. o. b. blast furnaces and do not include the value of ferro-alloys. The general average value for all grades of pig iron at furnaces was $24.49 a net ton in 1946, compared with $22.01 in 1945.

Average value per net ton of pig iron at blast furnaces in the United States, 1942–46, by States

State	1942	1943	1944	1945	1946
Alabama	$17.30	$17.35	$17.34	$18.39	$21.15
Illinois	21.40	21.43	20.92	22.98	25.17
Indiana	22.17	22.39	22.41	23.11	25.46
Michigan	15.35	16.60	17.21	17.60	27.19
New York	19.63	20.20	19.96	22.83	22.82
Ohio	21.64	21.78	21.96	22.99	24.90
Pennsylvania	21.51	21.49	21.48	22.37	24.70
Western States [1]	19.09	18.59	19.04	19.49	21.25
Other States [2]		19.48	20.10	20.48	24.95
Average for United States	20.77	20.95	20.97	22.01	24.49

[1] 1942: Colorado and Utah; 1943–46: California, Colorado, and Utah.
[2] Comprises Iowa, Kentucky, Maryland, Massachusetts, Minnesota, Tennessee, Texas, Virginia, and West Virginia.

The average monthly prices of foundry, basic, and Bessemer pig iron at Valley furnaces and of foundry pig iron at Birmingham furnaces, according to published market quotations, are summarized in the following table.

Average monthly prices per net ton of chief grades of pig iron, 1945–46

[Metal Statistics, 1947]

Month	Foundry pig iron at Birmingham furnaces		Foundry pig iron at Valley furnaces		Bessemer pig iron at Valley furnaces		Basic pig iron at Valley furnaces	
	1945	1946	1945	1946	1945	1946	1945	1946
January	$18.20	$19.76	$21.43	$22.99	$21.88	$23.44	$20.98	$22.54
February	18.68	19.76	21.91	22.99	22.36	23.44	21.46	22.54
March	19.09	20.12	22.32	23.35	22.77	23.79	21.88	22.90
April	19.09	20.43	22.32	23.66	22.77	24.11	21.88	23.21
May	19.09	20.56	22.32	23.79	22.77	24.24	21.88	23.35
June	19.09	22.21	22.32	25.45	22.77	25.89	21.88	25.00
July	19.09	22.21	22.32	25.45	22.77	25.89	21.88	25.00
August	19.09	22.21	22.32	25.45	22.77	25.89	21.88	25.00
September	19.09	22.21	22.32	25.45	22.77	25.89	21.88	25.00
October	19.29	22.21	22.52	25.45	22.96	25.89	22.07	25.00
November	19.76	22.21	22.99	25.45	23.44	25.89	22.54	25.00
December	19.76	23.50	22.99	26.59	23.44	27.04	22.54	26.14
Average	19.11	21.45	22.34	24.67	22.79	25.12	21.89	24.22

Composite prices of finished steel in the United States, 1937–46, by months, in cents per pound [1]

[Iron Age]

Month	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946
January	2.32263	2.58414	2.35367	2.30467	2.30467	2.28249	2.29176	2.27235	2.38444	2.54490
February	2.32263	2.58084	2.35367	2.30467	2.30467	2.28249	2.29176	2.27235	2.38444	2.54490
March	2.53185	2.57754	2.35367	2.30467	2.30467	2.28249	2.29176	2.27235	2.38444	2.54490
April	2.58414	2.57754	2.35367	2.26015	2.30467	2.28249	2.29176	2.30329	2.42471	2.73011
May	2.58414	2.56939	2.30807	2.30467	2.30467	2.28249	2.29176	2.30329	2.42471	2.73011
June	2.58414	2.51300	2.28297	2.30467	2.30467	2.28249	2.29176	2.30329	2.42471	2.73011
July	2.58414	2.35944	2.28297	2.30467	2.30467	2.28249	2.29176	2.30837	2.44076	2.70711
August	2.58414	2.35944	2.28297	2.30467	2.30467	2.28249	2.29176	2.30837	2.44076	2.70711
September	2.58414	2.35655	2.28297	2.30467	2.30467	2.28249	2.29176	2.30837	2.44076	2.70711
October	2.58414	2.31964	2.28297	2.30467	2.30467	2.28249	2.29176	2.21188	2.44104	[2] 2.70711
November	2.58414	2.35367	2.28837	2.30467	2.30467	2.28249	2.29176	2.21188	2.44104	[2] 2.70711
December	2.58414	2.35367	2.30467	2.30467	2.30467	2.28249	2.29176	2.21188	2.44104	[2] 2.74466
Average	2.53620	2.45874	2.31088	2.30096	2.30467	2.28249	2.29176	2.27298	2.42277	[2] 2.67544

[1] Weighted average of Iron Age quotations on following steel items: Hot-rolled and cold-rolled strip, sheets, bars, plates, shapes, wire rods, rails and pipe. The composite was revised in 1941 to obtain greater sensitivity in reflecting price changes. (For details of revisions see Iron Age, Aug. 28, 1941, p. 92.) Prior to 1941, this index was computed on the basis of finished steel shipments in the 10-year period 1929–39. The 3 years, 1941, 1942 and 1943, are based on annual shipments for the year. Since 1944, the index has been based on quarterly shipments.

[2] Estimate.

FOREIGN TRADE [2]

Imports of pig iron for consumption in 1946 decreased 34 percent quantitatively from 1945, but the value of imports increased 12 percent. Mexico supplied 80 percent of United States receipts during the year.

Pig iron imported for consumption in the United States, 1942–46,[1] by countries, in net tons

Country	1943	1944	1945	1946
North America:				
Canada	49	5,778	21,433	1,287
Mexico				11,248
Europe:				
Sweden				28
United Kingdom	560			1,528
Asia: India	500			
Oceania: Australia	336			
Total (net tons)	1,445	5,778	21,433	14,091
Value	$41,408	$116,408	$440,283	$492,519

[1] None imported in 1942.

Exports of pig iron from the United States increased 5 percent in quantity and 11 percent in value over 1945. Shipments went to at least 27 countries during the year, but Sweden and Italy were the main recipients, taking 25 and 18 percent, respectively, of the total.

[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Pig iron exported from the United States, 1945–46, by countries, in net tons

Country	1945	1946	Country	1945	1946
North America:			Europe—Continued		
Canada	6,106	11,789	Greece		695
Cuba	1,923	122	Italy	10,643	16,856
Dominican Republic		214	Portugal	2,842	2,316
Iceland	129		Sweden	22,062	24,082
Mexico	338	1	U. S. S. R.	376	
Other North America	104	194	United Kingdom	1,524	
South America:			Other Europe	710	112
Argentina	5,660	4,772	Asia:		
Bolivia	140	144	China		12,155
Chile	2,608	904	Palestine and Trans-Jordan	1,470	112
Colombia	3,661	756	Philippines, Republic of		60
Ecuador	236		Africa:		
El Salvador	124		Algeria	199	56
Paraguay	123	28	Belgian Congo	168	
Peru	1,877	854	Egypt	1,391	143
Uruguay	3,078	3,366	French West Africa	287	
Venezuela	836	497	Other Africa	493	111
Other South America	70	239			
Europe:			Total: Net tons	90,968	95,698
Belgium and Luxembourg	7,790		Value	$2,396,175	$2,670,369
Denmark		1,120			
France	14,000	14,000			

Imports and exports of iron and steel products are given in detail in the following tables.

Iron and steel imported for consumption in the United States, 1945–46, by commodities

Commodity	1945		1946	
	Net tons	Value	Net tons	Value
Semimanufactures:				
Steel bars:				
Concrete reinforcement bars			[1]	$23
Solid or hollow, n. e. s.	1,592	$180,028	863	183,311
Hollow and hollow drill steel	37	7,436	101	19,773
Bar iron	24	3,461	404	62,932
Wire rods, nail rods, and flat rods up to 6 inches in width	2,197	256,983	6,051	795,104
Boiler and other plate iron and steel, n. e. s.	72	47,443	2,048	124,846
Steel ingots, blooms, and slabs	1,655	115,774	589	44,968
Billets, solid or hollow	6,456	477,032	603	43,124
Die blocks or blanks; shafting, etc	212	71,703	273	69,083
Circular saw plates			[1]	397
Sheets of iron or steel, common or black and boiler or other plate iron or steel	91	8,330	113	11,568
Sheets and plates and steel, n. s. p. f.	2,487	225,472	91	20,092
Tin plate, terneplate, and taggers' tin	162	41,180	334	90,143
Total semimanufactures	14,985	1,434,842	11,470	1,465,364
Manufactures:				
Structural iron and steel	2,682	162,755	875	106,447
Rails for railways	27,766	573,773	5,771	113,678
Rail braces, bars, fishplates or splice bars, and tie plates	4,708	163,805	2,226	81,089
Pipes and tubes:				
Cast-iron pipe and fittings	8	2,229	215	42,959
Other pipes and tubes	908	136,973	203	26,045
Wire:				
Barbed	[1]	19		
Round wire, n. e. s.	21	4,588	207	40,341
Telegraph, telephone, etc., except copper, covered with cotton jute, etc	63	49,299	6	3,941
Flat wire and iron or steel strips	1,956	1,306,179	2,947	2,095,054
Rope and strand	2,415	949,064	294	89,483
Galvanized fencing wire and wire fencing			9	129
Hoop, band and strips, or scroll iron or steel, n. s. p. f.	98	112,422	50	65,944
Nails	27	14,774	183	53,222
Castings and forgings, n. e. s.	20,066	2,820,309	1,047	217,289
Total manufactures	60,718	6,296,189	14,033	2,935,621
Grand total	75,703	7,731,031	25,503	4,400,985

[1] Less than 1 ton.

Iron and steel exported from the United States, 1945–46,[1] by commodities

Commodity	1945		1946	
	Net tons	Value	Net tons	Value
Semimanufactures:				
Steel ingots, blooms, billets, slabs, and sheet bars	203,746	$10,664,091	452,534	$21,316,011
Iron and steel bars and rods:				
Iron bars	2,166	300,395	25,572	2,059,874
Concrete reinforcement bars	267,080	15,017,384	199,651	12,624,758
Other steel bars	332,456	35,240,227	478,637	37,727,642
Wire rods	109,334	5,493,116	62,355	3,838,543
Iron and steel plates, sheets, skelp, and strips:				
Boiler plates	25,543	1,517,602	61,703	3,766,241
Other plates, not fabricated	188,478	11,886,100	470,904	29,655,835
Skelp iron or steel	146,535	6,380,416	56,563	2,609,715
Iron and steel sheets, galvanized	174,746	15,158,621	77,747	7,556,987
Steel sheets, black, ungalvanized	742,423	53,291,346	482,783	46,077,869
Iron sheets, black	12,835	943,910	31,177	2,477,937
Strip band, and scroll iron or steel:				
Cold-rolled	57,756	7,853,605	64,626	9,323,516
Hot-rolled	84,668	6,505,636	84,376	6,323,882
Tin plate, terneplate, and taggers' tin	527,688	55,512,995	398,490	43,568,821
Total semimanufactures	2,875,454	225,765,444	2,947,118	228,927,631
Manufactures—steel-mill products:				
Structural iron and steel:				
Water, oil, gas, and other storage tanks complete and knocked-down material	33,371	4,394,255	49,331	5,872,907
Structural shapes:				
Not fabricated	286,412	14,428,679	319,103	18,074,652
Fabricated	57,378	8,711,478	99,477	14,890,198
Plates, fabricated, punched, or shaped	197,929	21,760,743	34,856	2,629,060
Metal lath	1,891	330,868	3,538	679,016
Frames, sashes, and sheet piling	22,620	1,431,836	27,356	2,092,382
Railway-track material:				
Rails for railways	327,994	14,439,299	385,583	18,520,263
Rail joints, splice bars, fishplates, and tie plates	69,245	4,313,944	53,072	4,164,363
Switches, frogs, and crossings	37,999	4,933,999	6,763	1,216,754
Railroad spikes	15,907	1,327,191	12,045	1,214,087
Railroad bolts, nuts, washers, and nut locks	6,419	1,078,990	8,470	1,372,811
Tubular products:				
Boiler tubes	52,724	8,140,464	44,565	6,688,123
Casing and oil-line pipe	256,770	24,522,719	179,781	18,912,327
Seamless black pipe, other than casing and oil line	21,576	2,355,272	14,870	1,838,380
Welded black pipe	65,325	6,206,191	85,280	8,174,177
Welded galvanized pipe	57,292	6,187,737	61,062	7,100,025
Malleable-iron screwed pipe fittings	3,681	1,534,075	4,431	1,924,231
Cast-iron screwed pipe fittings	938	278,819	1,030	302,017
Cast-iron pressure pipe and fittings	65,649	4,386,355	43,724	3,154,665
Cast-iron soil pipe and fittings	7,346	663,091	2,727	286,013
Riveted-steel or iron pipe and fittings	183,412	30,623,265	72,985	17,617,034
Wire and manufactures:				
Barbed	29,290	3,344,330	52,509	5,613,481
Galvanized wire	61,929	6,840,616	65,218	10,019,634
Iron and steel wire, uncoated	59,620	6,482,572	46,800	4,862,386
Wire rope and strand	31,607	12,300,784	34,710	11,594,081
Woven-wire fencing and screen cloth	9,646	3,027,289	13,258	3,815,838
All other	36,336	8,308,768	35,564	10,116,336
Nails and bolts (except railroad):				
Wire nails	31,264	2,870,862	19,102	2,046,774
Horseshoe nails	1,529	472,875	2,080	676,421
All other nails, including tacks and staples	9,549	1,822,689	9,570	2,013,472
Bolts, nuts, rivets, and washers (except aircraft and railroad)	41,805	10,638,205	31,622	9,216,175
Castings and forgings:				
Horseshoes and calks	1,681	260,174	1,859	274,969
Iron and steel, including car wheels, tires, and axles	140,995	20,052,876	121,396	15,202,594
Total manufactures	2,227,129	238,471,310	1,943,737	212,175,646
Advanced manufactures:				
House-heating boilers and radiators	----------	351,992	----------	527,680
Oil burners and parts	----------	2,299,341	----------	5,541,272
Tools:				
Axes	----------	684,018	----------	826,970
Shovels, spades, scoops, and drainage tools [1]	----------	1,028,657	----------	844,529
Hammers and hatchets	----------	1,124,035	----------	1,033,422
Saws, wood and metal cutting	----------	5,775,987	----------	5,260,775
All other tools [1]	----------	36,854,493	----------	34,383,214
Total advanced manufactures	----------	48,118,523	----------	48,417,862

[1] Changes for 1944 in table in Minerals Yearbook, 1945, p. 589, are as follows: Shovels, spades, etc., value should read $1,302,689; All other tools, value should read $40,906,297.

WORLD PRODUCTION

The following table shows the production of pig iron, by countries, in recent years insofar as statistics are available.

World production of pig iron (including ferro-alloys), 1940–46, by countries, in metric tons [1]

[Compiled by B. B. Mitchell]

Country [1]	1940	1941	1942	1943	1944	1945	1946
Australia [2]	1,231,459	1,499,392	1,582,641	1,412,620	1,326,308	1,140,000	888,000
Austria	678,509	652,300	783,481	965,000	926,178	101,549	57,868
Belgian Congo	[3] 600	(4)	(4)	(4)	(4)	(4)	(4)
Belgium	1,789,830	1,422,090	1,269,450	1,630,570	718,490	728,420	2,170,790
Brazil	185,570	208,795	213,619	247,680	294,573	259,909	[3] 365,000
Canada	1,323,115	1,566,171	1,981,309	1,773,866	1,836,088	1,782,551	1,379,597
Chile	(4)	(4)	2,000	4,637	18,413	172,242	(4)
China [5]	1,660,871	1,960,311	4,743,251	[6] 1,867,507	[6] 2,121,574	493,575	1,326
Czechoslovakia	1,620,000	1,572,000	1,596,000	1,704,000	1,584,000	576,000	961,000
Finland	26,193	22,170	28,886	43,277	100,303	36,798	(4)
France	[7] 3,472,440	[7] 1,541,960	[7] 1,621,730	[7] 2,183,725	[7] 1,126,903	1,198,673	3,502,000
Germany	13,955,000	15,433,000	15,441,000	15,972,000	13,370,000	(4)	[8] 2,322,000
Hungary [9]	426,840	444,720	420,470	420,620	[10] 296,100	12,000	160,270
India	2,026,241	2,042,123	1,859,108	1,776,941	1,453,713	1,417,309	1,347,000
Italy	1,121,786	1,109,914	[11] 889,259	[11] 643,806	[11] 230,995	[11] 65,838	[11] 171,760
Japan	[12] 3,629,518	[12] 4,366,158	[12] 4,362,249	[12] 4,103,813	[12] 2,114,177	[12] 1,165,855	185,000
Korea (Chosen)	239,600	300,256	398,428	543,492	567,856	[11] 138,000	(4)
Luxembourg	1,060,970	1,343,017	1,689,121	2,289,740	1,348,096	316,477	1,364,400
Mexico	[11] 93,179	[11] 96,638	[11] 123,761	[11] 123,325	135,157	218,322	282,243
Netherlands	[3] 284,000	(4)	(4)	(4)	(4)	(4)	(4)
Norway	147,535	123,294	110,838	144,855	123,745	(4)	(4)
Poland	(4)	(4)	(4)	(4)	(4)	228,249	738,414
Rumania	122,285	118,393	161,693	226,497	(4)	(4)	(4)
Spain	588,076	545,148	549,030	697,318	564,294	488,414	[10] 472,307
Sweden	787,211	749,470	770,773	831,769	888,219	785,359	699,800
Switzerland [3]	2,000	10,000	10,000	10,000	10,000	2,770	11,500
Turkey	81,248	86,057	67,350	55,259	69,795	69,524	78,886
Union of South Africa	303,923	360,000	362,800	486,800	471,520	555,700	560,000
U. S. S. R.	[3] 15,200,000	[3] 13,100,000	[3] 7,075,000	(4)	(4)	[3] 9,000,000	(4)
United Kingdom	8,336,700	7,510,600	7,726,000	7,302,250	6,844,621	7,221,474	7,885,564
United States	43,026,030	51,456,627	55,316,075	56,969,248	57,059,457	49,855,561	42,023,299
Yugoslavia	84,000	[13] 50,561	(4)	(4)	(4)	(4)	(4)
Total (estimate)	109,500,000	110,300,000	111,500,000	111,000,000	103,000,000	81,000,000	80,000,000

[1] Pig iron is also produced in French Indochina, New Zealand, and Republic of the Philippines, but quantity produced is believed insufficient to affect estimate of world total.
[2] Fiscal year ended June 30 of year stated.
[3] Estimate.
[4] Data not available, estimate by the author of chapter included in the total.
[5] Data represents areas designated as Free China during the period of Japanese occupation.
[6] Includes Manchuria.
[7] Excludes Alsace-Lorraine; data not available, 1940–44.
[8] Excludes Russian zone.
[9] Includes Northern Territories and Sub-Carpathia; in addition beginning in 1941 includes eastern Hungary and Transylvania; and beginning in 1942 includes Southern Territories.
[10] January to September, inclusive.
[11] Excluding ferro-alloy production, for which data are not yet available.
[12] Preliminary data for fiscal year ended March 31 of year following that stated.
[13] Croatia only.

Iron and Steel Scrap

By NORWOOD B. MELCHER AND JAMES E. LARKIN

	PAGE
General summary	642
Salient statistics	643
Government regulations	645
Civilian Production Administration	645
Office of Price Administration	645
Consumption	646
Consumption by districts and States	648
Consumption by type of furnace	651
Open-hearth furnaces	651
Bessemer converters	652
Electric steel furnaces	652
Consumption—Continued.	
Consumption by type of furnace—Continued.	
Cupolas	654
Air furnaces	655
Crucible and puddling furnaces	656
Blast furnaces	657
Use of scrap in ferro-alloy production	658
Miscellaneous uses	659
Stocks	661
Foreign trade	663
World review	664

GENERAL SUMMARY

THE 16-PERCENT drop in the output of steel ingots and castings during 1946 was accompanied by consumption of iron and steel scrap below that for any year since 1940. This drop in steel output did not reflect decreased demand but resulted from a series of strikes in the steel and associated industries that began with a general steel strike called in January. Steel operations were thereby reduced to the lowest operating rate in the history of the industry and production to the lowest level in 53 years. Consequently, ferrous scrap was consumed at a greatly reduced rate during the first 2 months of 1946, although partly sustained by foundry operations; purchased-scrap stocks accumulated to 3,168,000 net tons at the end of March, the highest of the year. After March purchased-scrap stocks declined without interruption until the close of the year, when stocks were at the lowest level since data were first available in 1939. The steel strike was followed by another by soft-coal miners that found the steel industry with only a 40-day supply of coal and resulted in an estimated loss of 750,000 tons of steel ingots during April and 2,000,000 in May. Curtailment of steel production during May caused steel producers to reduce scrap and pig-iron consumption to such a degree that the quantity of ferrous material consumed was the smallest for any month following the steel strike. Another work stoppage at soft-coal mines from November 21 to December 9, 1946, reduced further the production of steel and requirements for iron and steel scrap.

Salient statistics of ferrous scrap and pig iron in the United States, 1945–46

	1945 (Short tons)	1946 (Short tons)	Percent of change from 1945
Stocks, December 31:			
Ferrous scrap and pig iron at consumers' plants:			
Home scrap	1,218,493	1,230,276	+1
Purchased scrap	2,705,710	2,167,145	−20
Pig iron	1,237,058	915,168	−26
	5,161,261	4,312,589	−16
Consumption:			
Ferrous scrap and pig iron charged to—			
Steel furnaces: [1]			
Home scrap	25,236,910	19,868,551	−21
Purchased scrap	17,919,602	16,513,487	−8
Pig iron	46,596,855	38,443,934	−17
	89,753,367	74,825,972	−17
Iron furnaces: [2]			
Home scrap	5,645,923	6,193,237	+10
Purchased scrap	6,115,066	5,655,283	−8
Pig iron	6,590,322	6,626,505	+1
	18,351,311	18,475,025	+1
Miscellaneous uses [3] and ferro-alloy production:			
Home scrap	77,871	72,375	−7
Purchased scrap	1,195,713	1,181,178	−1
Pig iron		1,191	
	1,273,584	1,254,744	−1
All uses:			
Home scrap	30,960,704	26,134,163	−16
Purchased scrap	25,230,381	23,349,948	−7
Total ferrous scrap	56,191,085	49,484,111	−12
Pig iron	53,187,177	45,071,630	−15
	109,378,262	94,555,741	−14
Imports	66,511	57,701	−13
Exports:			
Iron and steel	79,259	136,280	+72
Tin plate, waste-waste, circles, strips, cobbles, etc	16,475	12,826	−22
Average prices per gross ton:			
Scrap:			
No. 1 Heavy-Melting, Pittsburgh [4]	$20.00	$21.08	+5
No. 1 Cast Cupola [4]	$20.00	$23.40	+17
For export	$30.30	$22.70	−25
Pig iron, f. o. b. Valley furnaces: [4]			
Basic	$24.52	$27.14	+11
No. 2 Foundry	$25.02	$27.64	+9

[1] Includes open-hearth, Bessemer, and electric furnaces.
[2] Includes cupola, air, Brackelsberg, puddling, crucible, and blast furnaces: also direct castings.
[3] Includes rerolling, reforging, copper precipitation, nonferrous and chemical uses.
[4] Iron Age.

These strikes and others in steel-consuming industries resulted in an over-all loss of steel production during the year, estimated at 16,000,000 net tons. After settlement of the spring coal strike, operations in the steel industry recovered rapidly, until in October steel output reached the high point for the year, when virtually 7,000,000 tons of steel ingots and castings were produced. The average operating rate during that month was 89 percent of capacity. This level was attained by melting 8,677,000 gross tons of ferrous materials (of which 49 percent was pig iron)—the highest melt of any month in 1946. The high rate of scrap consumption during the latter months of 1946, with a lag in return of new (prompt) scrap from fabricating industries, resulted in a lowering of stocks in consumers'

yards to less than a 30-day supply at the end of the year. An increase in the return of old (obsolescent) scrap was noticeable during the third quarter of the year as a result of the scrap drive inaugurated on July 15, 1946, by the Office of War Mobilization and Reconversion; but consumers were unable to increase their inventories of purchased scrap until December, when an increase in the return of new industrial scrap enabled consumers to increase scrap by a small margin.

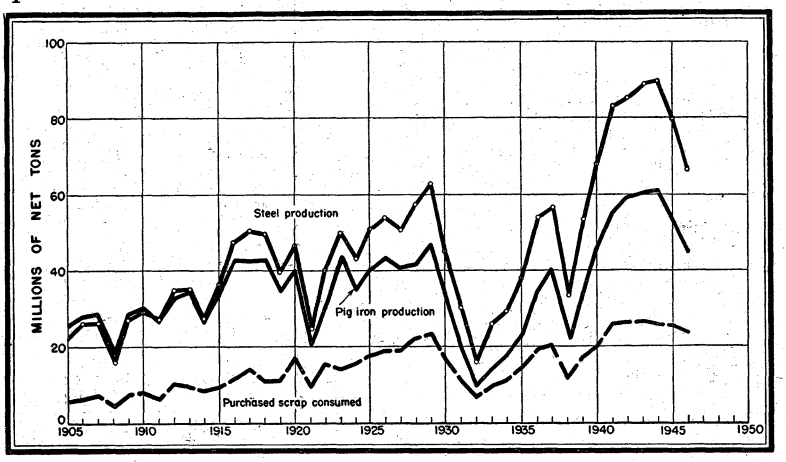

FIGURE 1.—Consumption of purchased scrap and output of pig iron and steel in the United States, 1905–46. Figures on consumption of purchased scrap for 1905–32 are from State of Minnesota vs. Oliver Iron Mining Co., et al., Exhibits, vol. 5, 1935, p. 328; those for 1933–34 are estimated by authors; and those for 1935–46 are based on Bureau of Mines reports. Data on output of steel are as given by the American Iron and Steel Institute.

The ferrous raw materials charged into steel-making furnaces during 1946 comprised 49 percent scrap and 51 percent pig iron compared with 48 percent and 52 percent, respectively, during 1945. However, the charge of scrap and pig iron used in iron foundries (mainly cupola furnaces) remained unchanged from 1945 and consisted of 64 and 36 percent, respectively. The apparent increase in the use of purchased scrap during the year was effected during periods of reduced steel production, when pig iron became very scarce, owing to shortages of coke for blast-furnace fuel. Thus, during August purchased scrap constituted 22 percent of the steel-furnace melt compared with 27 percent in June and 29 percent in May. The high rate of purchased scrap usage during the last quarter of 1946 was made at the expense of inventories in consumers' yards. The proportionately higher quantity of scrap used in all furnaces during 1946 resulted in a 20-percent decline in stocks of purchased scrap. Pig-iron stocks—the lowest since at least 1938 when this survey was inaugurated by the Bureau of Mines—were 26 percent less than at the end of 1945 and totaled 915,168 short tons.

In an effort to increase the supply of steel scrap available to consumers, a joint ship-breaking program was undertaken by the Navy, Maritime Commission, and War Assets Administration, and an increasing number of ships were declared surplus during 1946. To expedite the output of ship scrap from this program and move the product to the steel mills as quickly as possible, CPA established the

Office of Shipbreaking Consultant. During September, 14 Maritime Commission shipyards were made available for leasing by the War Assets Administration to companies which qualified as ship breakers. Of these, 3 were in New England, 5 on the Gulf coast, 3 in the Midwest, and 3 on the west coast. During October 8, additional Navy shipyards were made available. At the close of the year, 17 companies were engaged in the ship-breaking program, and 19 more had indicated an interest in entering the business. Several of the latter group had purchased ships but had not yet obtained facilities for breaking. In July 1946 it was estimated that steel scrap was being produced from ship breaking at a rate of 15,000 tons per month. This rate had increased to 33,000 tons in November and to 40,000 tons at the close of the year. In all, about 180,000 tons of scrap were produced by this program during 1946.

GOVERNMENT REGULATIONS

CIVILIAN PRODUCTION ADMINISTRATION

On October 22, 1946, the Civilian Production Administration issued an amended steel order M–21 in an effort to distribute equitably the dwindling supplies of iron and steel scrap. The regulation affected both consumers and dealers and closely followed an earlier plan approved by the Industry Advisory Committee for scrap. For consumers (including steel mills) inventories of usable scrap, whether prepared or unprepared and including both home and purchased scrap, were limited to a 45-day supply. Because of the greater scarcity of cast scrap, stocks of this material were limited to a 30-day supply. For scrap dealers and brokers the regulation stated that scrap could not be accepted which was not to be shipped in the following 2 months. To be effective January 5, 1947, and on the fifth of each succeeding month, a dealer or broker was to report to the CPA when his shipment in the 2 preceding calendar months was less than the tonnage required to be shipped to balance receipts for the third preceding month. Where such receipts and shipments did not balance as indicated above, a scrap dealer or broker was to furnish the following information to the CPA: (1) His receipts of scrap during the past 3 calendar months, by months; (2) the reason he was unable to balance his receipts for the third preceding calendar month, by his shipments during the past 2 months; (3) his current inventory. The order applied to each operating unit when a person or company maintained more than one.

OFFICE OF PRICE ADMINISTRATION

To prevent possible hoarding by speculators and to assure the maximum flow of iron and steel scrap to industry through normal channels, Paul A. Porter, Price Administrator, announced a six-point scrap program on September 10, 1946, that kept the current price ceilings unchanged, except for cast-iron scrap. The program: (1) Established ceiling prices for the first time on sales of unprepared scrap to scrap dealers from industrial or Government sources; (2) reduced ceiling prices on sales of unprepared scrap to consumers or their brokers 50 cents a ton, which gave dealers a differential to insure the flow of

scrap through this channel; (3) prohibited the purchase or sale of scrap on the condition that the buyer deliver any other commodity to the seller; (4) prohibited sale of electric-furnace and foundry grades of scrap at premium prices for use in basic open-hearth furnaces, unless the scrap had been allocated by the CPA; (5) provided incentive increases ranging from $2.50 to $7 per gross ton in the maximum prices of prepared grades of cast iron; (6) provided for increases in the Office of Price Administration staff of expert graders assigned to scrap and for a drive for criminal prosecution in appropriate cases of violators of OPA scrap regulations.

For the first time since April 3, 1941, iron and steel scrap (as well as other scrap and metals) was restored to a free market when the Price Administrator abolished wartime control, effective November 10, 1946. This action had an almost immediate effect upon the price of ferrous scrap. The composite price of steel-making scrap, as reported by the magazine Steel, increased from a ceiling of $19.17 per gross ton to $27.68 early in December and jumped to $30.75 on December 21 and $31.08 on December 28, 1946. No. 1 cast-iron scrap doubled in price from the $20 ceiling to $40 per ton by the end of the year.

CONSUMPTION

The large use of scrap as compared with that of pig iron, as in 1945, again was noticeable in the New England, Southwestern, and Pacific Coast districts in 1946. These districts together used 7 percent of the total scrap consumed in the United States but only 2 percent of the pig iron. The average ratio of scrap to pig iron in these three districts was 3.7:1, whereas for the United States at large it was 1.1:1.

Open-hearth steel furnaces are by far the largest consumers of ferrous scrap and pig iron. The proportions of the total scrap and pig-iron supply used in open-hearth furnaces have remained relatively constant, as the following data show: Open-hearth consumption accounted for 66 percent of the total scrap in 1946, 67 percent in 1945, and 67 percent in 1944; 69 percent of the home scrap in 1946, 73 percent in both 1945 and 1944; and 61 percent of the purchased scrap in 1946, 60 percent in 1945, and 57 percent in 1944.

Cupola-furnace consumption in 1946 increased as follows: Home scrap, 17 percent of the total compared with 12 percent in 1945 and 10 percent in 1944 and 1943; purchased scrap, 18 percent compared with 15 percent in 1945 and 1944; pig iron, 10 percent compared with 8 percent in 1945 and 6 percent in 1944 and 1943.

Bessemer converters consumed 8 percent of the pig iron in 1946 compared with 9 percent in 1945 and 1944 and 0.5 percent of the scrap compared with 0.6 percent in 1945.

Electric furnaces consumed 7 percent of the total scrap compared with 9 percent in 1945 and 10 percent in 1944 and 0.3 percent of the pig iron—unchanged from 1945.

In gathering data on the consumption of scrap in 1946, the practice of the past few years was continued, in that figures on the use of scrap in the production of ferro-alloys and for various miscellaneous uses

are included. Figures for some States are grouped to avoid disclosing the details of individual operations.

Ferrous scrap and pig iron consumed in the United States and percent of total derived from home scrap, purchased scrap, and pig iron, 1945–46, by districts

District	1945					1946				
	Total used (short tons)	Percent of total used				Total used (short tons)	Percent of total used			
		Scrap			Pig iron		Scrap			Pig iron
		Home	Purchased	Total			Home	Purchased	Total	
New England	1,164,614	30.8	38.8	69.6	30.4	1,167,414	33.7	40.9	74.6	25.4
Middle Atlantic	36,813,199	28.2	20.2	48.4	51.6	30,549,333	27.2	21.7	48.9	51.1
Southeastern	13,666,270	25.4	20.0	45.4	54.6	12,304,512	25.6	20.7	46.3	53.7
Southwestern	765,941	26.8	49.4	76.2	23.8	601,479	23.1	67.0	90.1	9.9
North Central	52,224,035	29.2	23.6	52.8	47.2	45,739,590	28.5	25.2	53.7	46.3
Rocky Mountain	2,272,451	26.9	26.1	53.0	47.0	1,688,468	29.4	25.4	54.8	45.2
Pacific Coast	2,471,752	27.1	52.2	79.3	20.7	2,504,945	23.5	54.4	77.9	22.1
	109,378,262	28.3	23.1	51.4	48.6	94,555,741	27.6	24.7	52.3	47.7

Proportion of home and purchased scrap and pig iron used in furnace charges in the United States, 1945–46, in percent

Type of furnace	1945				1946			
	Scrap			Pig iron	Scrap			Pig iron
	Home	Purchased	Total		Home	Purchased	Total	
Open-hearth	28.5	19.0	47.5	52.5	27.1	21.3	48.4	51.6
Bessemer	4.6	1.7	6.3	93.7	4.4	1.7	6.1	93.9
Electric	45.3	51.6	96.9	3.1	40.7	56.3	97.0	3.0
Cupola	31.6	32.7	64.3	35.7	32.9	32.1	65.0	35.0
Air [1]	49.3	21.8	71.1	28.9	50.8	23.1	73.9	26.1
Crucible	32.8	26.3	59.1	40.9	28.4	38.8	67.2	32.8
Puddling	2.8	22.8	25.6	74.4	-------	18.2	18.2	81.8
Blast	38.6	61.4	100.0	-------	51.4	48.6	100.0	-------

[1] Includes data for 2 Brackelsberg furnaces.

Consumption of ferrous scrap and pig iron in the United States, 1945–46, by type of furnace, in short tons

Type of furnace or equipment	Active plants reporting [1]	Scrap			Pig iron
		Home	Purchased	Total	
1945					
Open-hearth	140	22,628,604	15,127,687	37,756,291	41,682,581
Bessemer	37	234,034	82,856	316,890	4,750,817
Electric	364	2,374,272	2,709,059	5,083,331	163,457
Cupola	2,532	3,614,006	3,729,761	7,343,767	4,084,091
Air	123	741,096	328,828	1,069,924	433,953
Brackelsberg	2				
Crucible	13	442	355	797	552
Puddling	7	842	6,982	7,824	22,725
Blast	74	1,289,537	2,049,140	3,338,677	
Direct castings	36				2,049,001
Ferro-alloy	21	19,088	292,707	311,795	
Miscellaneous	144	58,783	903,006	961,789	
	3,493	30,960,704	25,230,381	56,191,085	53,187,177
1946					
Open-hearth	131	18,145,617	14,295,908	32,441,525	34,608,053
Bessemer	31	173,025	69,550	242,575	3,722,756
Electric	332	1,549,909	2,148,029	3,697,938	113,125
Cupola	2,501	4,329,283	4,229,939	8,559,222	4,612,704
Air	118	694,509	316,595	1,011,104	356,436
Brackelsberg	2				
Crucible	12	855	1,166	2,021	985
Puddling	4		3,235	3,235	14,506
Blast	68	1,168,590	1,104,348	2,272,938	
Direct castings	32				1,641,874
Ferro-alloy	20	17,096	258,754	275,850	
Miscellaneous	130	55,279	922,424	977,703	1,191
	3,381	26,134,163	23,349,948	49,484,111	45,071,630

[1] Where 2 or more separate departments, such as blast-furnace, open-hearth, foundry, etc., are situated at the same place and are operated by 1 establishment, each department is counted as 1 plant.

CONSUMPTION BY DISTRICTS AND STATES

In 1946 iron and steel scrap and pig iron were used in all 48 States and the District of Columbia; none was used in Alaska. As in 1945, the largest consuming districts in 1946 were the North Central, Middle Atlantic, and Southeastern. The New England district showed an increase over 1945 in total scrap consumed, but all other districts showed a decrease during the year. Pig-iron use increased in only the Pacific Coast district. The nine States having the largest consumption of scrap, together with the percentage consumed, were: Pennsylvania 24, Ohio 18, Indiana 10, Illinois 10, Michigan 7, New York 5, Alabama 4, Maryland 3, and California 3. This order varies slightly from 1945; Alabama and Maryland changed positions. Pennsylvania, Ohio, Indiana, and Illinois remained the leading States in iron- and steel-scrap consumption.

Consumption of ferrous scrap and pig iron in the United States, 1942–46, by districts

District and year	Active plants reporting [1]	Scrap						Pig iron	
		Home		Purchased		Total			
		Short tons	Change from previous year (percent)	Short tons	Change from previous year (percent)	Short tons	Change from previous year (percent)	Short tons	Change from previous year (percent)
New England:									
1942	271	494,569	+1.1	616,166	+8.7	1,110,735	+5.2	491,986	+3.2
1943	266	467,711	−5.4	538,469	−12.6	1,006,180	−9.4	412,523	−16.2
1944	255	396,205	−15.3	472,742	−12.2	868,947	−13.6	359,929	−12.8
1945	248	358,866	−9.4	451,237	−4.5	810,103	−6.8	354,511	−1.5
1946	240	392,656	+9.4	477,788	+5.9	870,444	+7.4	296,970	−16.2
Middle Atlantic:									
1942	914	11,190,820	−2.5	8,446,963	+8.3	19,637,783	+1.9	22,392,004	+7.7
1943	916	12,292,266	+9.8	8,251,262	−2.3	20,543,528	+4.6	22,815,315	+1.9
1944	880	12,395,873	+.8	7,907,164	−4.2	20,303,037	−1.2	22,409,490	−1.8
1945	858	10,401,507	−16.1	7,434,229	−6.0	17,835,736	−12.2	18,977,463	−15.3
1946	818	8,319,887	−20.0	6,614,440	−11.0	14,934,327	−16.3	15,615,006	−17.7
Southeastern:									
1942	526	3,669,073	−2.5	2,981,358	+5.5	6,650,431	+1.0	8,356,308	+8.5
1943	512	3,857,196	+5.1	2,540,189	−14.8	6,397,385	−3.8	8,247,742	−1.3
1944	501	3,861,555	+.1	2,763,586	+8.8	6,625,141	+3.6	8,396,796	+1.8
1945	485	3,474,945	−10.0	2,731,033	−1.2	6,205,978	−6.3	7,460,292	−11.2
1946	476	3,144,778	−9.5	2,547,664	−6.7	5,692,442	−8.3	6,612,070	−11.4
Southwestern:									
1942	138	101,683	+37.3	352,460	+63.4	454,143	+56.7	7,481	+31.1
1943	136	141,916	+39.6	454,731	+29.0	596,647	+31.4	27,813	+271.8
1944	134	193,181	+36.1	356,371	−21.6	549,552	−7.9	158,884	+471.3
1945	131	204,882	+6.1	378,618	+6.2	583,500	+6.2	182,441	+14.8
1946	121	139,038	−32.1	402,683	+6.4	541,721	−7.2	59,758	−67.2
North Central:									
1942	1,480	16,793,338	−2.5	12,814,917	+3.9	29,608,255	+.2	26,855,971	+1.9
1943	1,442	17,276,757	+2.9	12,685,489	−1.0	29,962,246	+1.2	27,605,420	+2.8
1944	1,426	17,284,440		12,281,465	−3.2	29,565,905	−1.3	27,903,417	+1.1
1945	1,380	15,237,692	−11.8	12,352,904	+.6	27,590,596	−6.7	24,633,439	−11.7
1946	1,357	13,053,967	−14.3	11,515,917	−6.8	24,569,884	−10.9	21,169,706	−14.1
Rocky Mountain:									
1942	87	436,470	+3.6	533,604	+19.4	970,074	+11.8	666,938	+3.4
1943	91	456,135	+4.5	570,034	+6.8	1,026,169	+5.8	722,221	+8.3
1944	92	598,494	+31.2	691,503	+21.3	1,289,997	+25.7	1,083,002	+50.0
1945	91	612,360	+2.3	592,431	−14.3	1,204,791	−6.6	1,067,660	−1.4
1946	90	496,260	−19.0	428,171	−27.7	924,431	−23.3	764,037	−28.4
Pacific Coast:									
1942	285	443,419	−3.3	1,390,311	+22.9	1,833,730	+15.4	272,195	+28.3
1943	317	545,107	+22.9	1,573,694	+13.2	2,118,801	+15.5	484,125	+77.9
1944	324	696,601	+27.8	1,450,021	−7.9	2,146,622	+1.3	640,103	+32.1
1945	300	670,452	−3.8	1,289,929	−11.0	1,960,381	−8.7	511,371	−20.1
1946	279	587,577	−12.4	1,363,285	+5.7	1,950,862	−.5	554,083	+8.4
United States:									
1942	3,701	33,129,372	−2.3	27,135,779	+7.2	60,265,151	+1.8	59,042,883	+5.1
1943	3,680	35,037,088	+5.8	26,613,868	−1.9	61,650,956	+2.3	60,315,159	+2.2
1944	3,612	35,426,349	+1.1	25,922,852	−2.6	61,349,201	−.5	60,951,621	+1.1
1945	3,493	30,960,704	−12.6	25,230,381	−2.7	56,191,085	−8.4	53,187,177	−12.7
1946	3,381	26,134,163	−15.6	23,349,948	−7.5	49,484,111	−11.9	45,071,630	−15.3

[1] Where 2 or more separate departments, such as blast-furnace, open-hearth, foundry, etc., are situated at the same place and are operated by 1 establishment, each department is counted as 1 plant.

Consumption of ferrous scrap and pig iron in the United States in 1946, by States and districts

State and district	Active plants reporting	Scrap						Pig iron	
		Home		Purchased		Total			
		Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Connecticut	65	121,784	0.5	151,548	0.6	273,332	0.6	88,307	0.2
Maine	20	13,090	.1	10,968	(1)	24,058	(1)	10,267	(1)
Massachusetts	113	202,884	.8	249,982	1.1	452,866	.9	154,654	.4
New Hampshire	18	7,412	(1)	12,102	.1	19,514	(1)	5,992	(1)
Rhode Island	11	35,458	.1	39,669	.2	75,127	.2	28,339	.1
Vermont	13	12,028	(1)	13,519	.1	25,547	.1	9,411	(1)
Total New England	240	392,656	1.5	477,788	2.1	870,444	1.8	296,970	.7
Delaware	9	316,377	1.2	497,584	2.1	813,961	1.7	292,498	.6
New Jersey	110								
New York	219	1,270,190	4.8	1,116,908	4.8	2,387,098	4.8	2,201,586	4.9
Pennsylvania	480	6,733,320	25.8	4,999,948	21.4	11,733,268	23.7	13,120,922	29.1
Total Middle Atlantic	818	8,319,887	31.8	6,614,440	28.3	14,934,327	30.2	15,615,006	34.6
Alabama	89	1,209,778	4.6	567,943	2.4	1,777,721	3.6	2,568,276	5.7
District of Columbia	3	1,304,532	5.0	909,596	3.9	2,214,128	4.5	2,629,314	5.8
Kentucky	26								
Maryland	31								
Florida	18	47,239	.2	116,312	.5	163,551	.3	63,613	.2
Georgia	60								
Mississippi	12	1,636	(1)	2,185	(1)	3,821	(1)	2,256	(1)
North Carolina	53	16,341	.1	11,741	.1	28,082	.1	28,423	.1
South Carolina	22	5,424	(1)	8,504	(1)	13,928	(1)	7,348	(1)
Tennessee	63	179,549	.7	212,059	.9	391,608	.8	197,055	.4
Virginia	66								
West Virginia	33	380,279	1.4	719,324	3.1	1,099,603	2.2	1,115,785	2.5
Total Southeastern	476	3,144,778	12.0	2,547,664	10.9	5,692,442	11.5	6,612,070	14.7
Arkansas	11	18,680	.1	54,617	.2	73,297	.2	5,620	(1)
Louisiana	27								
Oklahoma	18								
Texas	65	120,358	.4	348,066	1.5	468,424	.9	54,138	.1
Total Southwestern	121	139,038	.5	402,683	1.7	541,721	1.1	59,758	.1
Illinois	248	2,434,972	9.3	2,523,720	10.8	4,958,692	10.0	3,716,293	8.3
Indiana	148	2,986,728	11.4	2,124,368	9.1	5,111,096	10.3	5,356,288	11.9
Iowa	61	132,718	.5	234,667	1.0	367,385	.7	104,744	.2
Kansas	33	31,611	.1	77,901	.3	109,512	.2	16,901	(1)
Nebraska	15								
Michigan	201	2,265,232	8.9	1,816,028	7.8	4,081,260	8.2	2,275,887	5.1
Wisconsin	131								
Minnesota	75	219,092	.8	258,775	1.1	477,867	1.0	443,861	1.0
Missouri	67	187,916	.7	488,708	2.1	676,624	1.4	93,298	.2
North Dakota	2	955	(1)	689	(1)	1,644	(1)	316	(1)
South Dakota	1								
Ohio	375	4,794,743	18.3	3,991,061	17.1	8,785,804	17.8	9,162,118	20.3
Total North Central	1,357	13,053,967	50.0	11,515,917	49.3	24,569,884	49.6	21,169,706	47.0
Arizona	11	9,138	(1)	62,062	.2	71,200	.2	1,022	(1)
Nevada	3								
New Mexico	4								
Colorado	28	482,423	1.9	345,895	1.5	828,318	1.7	761,468	1.7
Utah	25								
Idaho	6	932	(1)	5,190	(1)	6,122	(1)	1,547	(1)
Wyoming	2	2	(1)	6	(1)	8	(1)		
Montana	11	3,765	(1)	15,018	.1	18,783	(1)		
Total Rocky Mountain	90	496,260	1.9	428,171	1.8	924,431	1.9	764,037	1.7
Oregon	45	90,400	.4	314,963	1.4	405,363	.8	33,795	.1
Washington	62								
California	172	497,177	1.9	1,048,322	4.5	1,545,499	3.1	520,288	1.1
Total Pacific Coast	279	587,577	2.3	1,363,285	5.9	1,950,862	3.9	554,083	1.2
Total United States:									
1946	[2] 3,381	26,134,163	100.0	23,349,948	100.0	49,484,111	100.0	45,071,630	100.0
1945	[2] 3,493	30,960,704	100.0	25,230,381	100.0	56,191,085	100.0	53,187,177	100.0

[1] Less than 0.05 percent.

[2] Where 2 or more separate departments, such as blast-furnace, open-hearth, foundry, etc., are situated at the same place and are operated by 1 establishment, each department is counted as 1 plant.

CONSUMPTION BY TYPE OF FURNACE

Open-Hearth Furnaces.—Ferrous scrap and pig iron consumed in open-hearth furnaces in 1946 totaled 67,049,578 short tons, a 16-percent decrease from 1945. The use of home scrap decreased 20 percent, purchased scrap 5 percent, total scrap 14 percent, and pig iron 17 percent. However, there was no change in the open-hearth furnace melt, which consisted of 48 percent total scrap and 52 percent pig iron. Of the total scrap consumed, 44 percent was purchased compared with 40 percent in 1945 and 36 percent in 1944.

Pennsylvania led in the use of scrap in the open-hearth in 1946, followed in order by Ohio, Indiana, and Illinois; this ranking was unchanged from 1945 and 1944.

Consumption of ferrous scrap and pig iron in open-hearth furnaces in the United States in 1946, by districts and States, in short tons

District and State	Active Plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	1				
Massachusetts	2	102,723	208,424	311,147	92,467
Rhode Island	1				
Total: 1946	4	102,723	208,424	311,147	92,467
1945	4	111,236	231,104	342,340	135,624
Middle Atlantic:					
Delaware	1				
New Jersey	2	1,049,383	762,279	1,811,662	1,963,423
New York	8				
Pennsylvania	46	5,278,047	3,691,117	8,969,164	10,543,660
Total: 1946	57	6,327,430	4,453,396	10,780,826	12,507,083
1945	63	8,086,429	4,756,791	12,843,220	15,381,631
Southeastern and Southwestern:					
Alabama	2				
Georgia	1				
Tennessee	1	806,002	597,063	1,403,065	1,961,338
Texas	1				
Kentucky	1				
Maryland	2				
Oklahoma	1	1,484,392	1,290,749	2,775,141	3,205,862
West Virginia	2				
Total: 1946	11	2,290,394	1,887,812	4,178,206	5,167,200
1945	11	2,795,325	1,788,177	4,583,502	6,200,509
North Central:					
Illinois	11	1,499,851	1,359,749	2,859,600	2,628,113
Indiana	7	2,579,987	1,845,409	4,425,396	4,801,916
Michigan	4	791,976	536,654	1,328,630	1,263,408
Missouri	2				
Minnesota	1	259,145	452,374	711,519	425,764
Wisconsin	2				
Ohio	23	3,527,513	2,459,353	5,986,866	6,595,838
Total: 1946	50	8,658,472	6,653,539	15,312,011	15,715,039
1945	52	10,675,597	7,192,219	17,867,816	18,574,441
Rocky Mountain and Pacific Coast:					
Colorado	1				
California	6	766,598	1,092,737	1,859,335	1,126,264
Utah	1				
Washington	1				
Total: 1946	9	766,598	1,092,737	1,859,335	1,126,264
1945	10	960,017	1,159,396	2,119,413	1,390,376
Total United States: 1946	131	18,145,617	14,295,908	32,441,525	34,608,053
1945	140	22,628,604	15,127,687	37,756,291	41,682,581

Bessemer Converters.—The 3,965,331 short tons of ferrous raw materials used in Bessemer converters in 1946 represents a 22-percent decrease from the 1945 use of these materials. The proportion of scrap in the metal charges was 6 percent, of which 71 percent was home scrap.

Following the usual pattern, Pennsylvania was the principal consumer of scrap in converters in 1946.

Consumption of ferrous scrap and pig iron in Bessemer converters in the United States in 1946, by districts and States, in short tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England and Middle Atlantic:					
Connecticut	1				
Delaware	2	4,583	3,840	8,423	2,268
New York	1				
Pennsylvania	9	72,383	30,328	102,711	1,346,011
Total: 1946	13	76,966	34,168	111,134	1,348,279
1945	17	88,082	39,239	127,321	1,652,253
Southeastern and Southwestern:					
Alabama	1				
Maryland	1				
West Virginia	1	26,176	20,080	46,256	359,750
Louisiana	1				
Texas	1				
Total: 1946	5	26,176	20,080	46,256	359,750
1945	6	21,595	20,159	41,754	451,419
North Central and Pacific Coast:					
Illinois	3	8,100	9,794	17,894	179,784
Indiana	1				
Iowa	1	11,599	5,272	16,871	263,607
Michigan	1				
Minnesota	1				
Missouri	1	105	152	257	69
Washington	1				
Ohio	4	50,079	84	50,163	1,571,267
Total: 1946	13	69,883	15,302	85,185	2,014,727
1945	14	124,357	23,458	147,815	2,647,145
Total United States: 1946	31	173,025	69,550	242,575	3,722,756
1945	37	234,034	82,856	316,890	4,750,817

Electric Steel Furnaces.—Shortages of suitable steel scrap, especially low-phosphorus grades for use in electric furnaces, together with a sharp drop in demand for alloy steel during 1946, resulted in an average operating rate for electric furnaces during 1946 of 47 percent of capacity compared with 64 percent in 1945. The sharp drop in electric-furnace production was reflected in the consumption of ferrous scrap in electric furnaces during the year. The total melt of ferrous scrap and pig iron used in electric furnaces in 1946 amounted to 3,811,063 net tons, a decrease of 27 percent from the 5,246,788 tons used in 1945. Decreases in the use of scrap and pig iron were apparent in all districts during the year.

Consumption of ferrous scrap and pig iron in electric steel furnaces in the United States in 1946, by districts and States, in short tons

District and State	Active Plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	3	8,785	7,618	16,403	1,267
New Hampshire	1				
Massachusetts	9	12,437	8,838	21,275	273
Total: 1946	13	21,222	16,456	37,678	1,540
1945	18	34,349	23,391	57,740	1,778
Middle Atlantic:					
Delaware	1	11,332	16,985	28,317	207
New Jersey	13				
New York	19	57,736	70,868	128,604	9,433
Pennsylvania	57	442,541	415,502	858,043	13,321
Total: 1946	90	511,609	503,355	1,014,964	22,961
1945	97	810,042	740,994	1,551,036	23,260
Southeastern:					
District of Columbia	1	18,198	47,622	65,820	268
Kentucky	1				
Maryland	3				
West Virginia	1				
Alabama	5	18,133	17,935	36,068	356
Florida	1				
Georgia	3				
North Carolina	1	7,434	10,764	18,198	703
South Carolina	1				
Tennessee	4				
Virginia	4				
Total: 1946	25	43,765	76,321	120,086	1,327
1945	26	71,465	120,143	191,608	1,955
Southwestern:					
Arkansas	1	29,359	30,091	59,450	445
Oklahoma	1				
Louisiana	4				
Texas	9				
Total: 1946	15	29,359	30,091	59,450	445
1945	18	44,168	41,736	85,904	1,579
North Central:					
Illinois	25	266,096	382,295	648,391	19,586
Indiana	11	32,569	22,853	55,422	2,487
Iowa	1	8,442	8,808	17,250	378
Kansas	1				
Nebraska	1				
Michigan	25	96,087	238,284	334,371	20,491
Minnesota	4	5,592	8,386	13,978	234
Missouri	8	13,708	15,822	29,530	1,777
Ohio	35	364,703	512,902	877,605	34,756
Wisconsin	12	56,742	67,831	124,573	4,160
Total: 1946	123	843,239	1,257,181	2,101,120	83,869
1945	135	1,247,825	1,523,155	2,770,980	131,067
Rocky Mountain:					
Arizona	2	5,664	9,996	15,660	388
Colorado	2				
Nevada	1				
Utah	1				
Total: 1946	6	5,664	9,996	15,660	388
1945	6	6,587	13,391	19,978	475
Pacific Coast:					
Oregon	9	16,468	58,660	75,128	98
California	32	60,539	133,591	194,130	2,140
Washington	19	17,344	62,378	79,722	357
Total: 1946	60	94,351	254,629	348,980	2,595
1945	64	159,836	246,249	406,085	3,343
Total United States: 1946	332	1,549,909	2,148,029	3,697,938	113,125
1945	364	2,374,272	2,709,059	5,083,331	163,457

Cupolas.—The gray-iron foundry industry was relatively unaffected by work stoppages during 1946, and shipments of castings increased 4 percent over 1945. Consequently, requirements for scrap and pig iron for cupola consumption increased during 1946. Cupola furnaces used 13,171,926 net tons of scrap and pig iron, an increase of 15 percent over the 11,427,858 tons used in 1945. The use of home scrap increased 20 percent, purchased scrap 13 percent, total scrap 17 percent, and pig iron 13 percent. In spite of this increased activity during the year, iron foundries were unable to fulfill their demands, and unfilled orders at the end of the year totaled 3.0 million tons compared with 1.9 million tons at the end of 1945.

Charges to cupolas consisted of 33 percent home scrap, 32 percent purchased scrap, and 35 percent pig iron, compared with 31, 33, and 36 percent, respectively, in 1945.

Michigan continued to be the largest consumer of cupola scrap in 1946, followed in order by Ohio, Illinois, Pennsylvania, New York, Alabama, and Indiana.

Consumption of ferrous scrap and pig iron in cupola furnaces in the United States in 1946, by districts and States, in short tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	50	66,246	55,134	121,380	60,043
Maine	20	13,090	10,968	24,058	10,267
Massachusetts	93	111,855	113,621	225,476	86,739
New Hampshire	15	3,014	11,014	14,028	3,933
Rhode Island	10	19,597	16,552	36,149	13,314
Vermont	13	12,028	13,519	25,547	9,411
Total: 1946	201	225,830	220,808	446,638	183,707
1945	204	172,849	169,164	342,013	193,564
Middle Atlantic:					
Delaware	4	3,159	4,364	7,523	3,505
New Jersey	76	138,945	207,569	346,514	153,270
New York	157	253,331	221,735	475,066	258,968
Pennsylvania	289	364,135	400,799	764,934	504,827
Total: 1946	526	759,570	834,467	1,594,037	920,570
1945	528	640,802	727,099	1,367,901	877,226
Southeastern:					
Alabama	71	306,394	151,439	457,833	638,827
District of Columbia	1	51,813	60,336	112,149	39,047
Maryland	23				
Florida	17	1,672	3,709	5,381	2,375
Georgia	54	19,293	30,262	49,555	29,982
Kentucky	21	31,872	19,593	51,465	83,775
Mississippi	12	1,636	2,185	3,821	2,256
North Carolina	52	16,275	11,741	28,016	28,321
South Carolina	20	5,364	4,009	9,373	7,338
Tennessee	55	122,162	89,759	211,921	137,430
Virginia	60	49,187	91,930	141,117	58,271
West Virginia	21	9,065	26,059	35,124	7,207
Total: 1946	407	614,733	491,022	1,105,755	1,034,829
1945	410	477,035	411,890	888,925	846,369

Consumption of ferrous scrap and pig iron in cupola furnaces in the United States in 1946, by districts and States, in short tons—Continued

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
Southwestern:					
Arkansas	10	448	1,854	2,302	453
Louisiana	20	2,407	4,125	6,532	2,344
Oklahoma	15	3,383	8,307	11,690	2,701
Texas	50	30,478	86,810	117,288	23,742
Total: 1946	95	36,716	101,096	137,812	29,240
1945	102	35,485	88,301	123,786	32,382
North Central:					
Illinois	180	452,840	404,640	857,480	361,584
Indiana	113	257,818	199,763	457,581	251,109
Iowa	57	115,718	111,519	227,237	99,940
Kansas	31	19,984	63,918	83,902	11,932
Michigan	160	901,802	623,019	1,524,821	709,382
Minnesota	63	48,181	98,224	146,405	49,550
Missouri	51	78,665	147,636	226,301	60,217
Nebraska	13	5,429	8,495	13,924	3,792
North Dakota	2	955	689	1,644	316
South Dakota	1				
Ohio	252	429,837	455,953	885,790	524,324
Wisconsin	103	220,290	168,928	389,218	212,120
Total: 1946	1,026	2,531,519	2,282,784	4,814,303	2,284,266
1945	1,029	2,144,582	2,026,175	4,170,757	1,983,246
Rocky Mountain:					
Arizona	4	7,223	19,168	26,391	833
Colorado	21	19,431	50,033	69,464	26,966
Idaho	5	700	2,801	3,501	212
Montana	8	3,336	3,312	6,648	141
New Mexico	2	304	5,320	5,624	132
Wyoming	2	2	6	8	3
Utah	14	37,789	25,408	63,197	32,522
Total: 1946	56	68,785	106,048	174,833	60,809
1945	57	57,368	121,437	178,805	59,133
Pacific Coast:					
California	119	70,990	133,271	204,261	79,489
Oregon	34	9,825	24,936	34,761	12,589
Washington	37	11,315	35,507	46,822	7,205
Total: 1946	190	92,130	193,714	285,844	99,283
1945	202	85,885	185,695	271,580	92,171
Total United States: 1946	2,501	4,329,283	4,229,939	8,559,222	4,612,704
1945	2,532	3,614,006	3,729,761	7,343,767	4,084,091

Air Furnaces.—Scrap and pig iron consumed in air furnaces (including 2 Brackelsbergs) in 1946 amounted to 1,367,540 short tons, a 9-percent decrease from the 1,503,877 tons melted in these furnaces in 1945. The use of home scrap decreased 6 percent, purchased scrap 4 percent, and pig iron 18 percent.

There was a change in the relative position of the principal consuming States; Indiana, which dropped to the sixth ranking State in 1945, advanced to the fifth position in 1946 ahead of Wisconsin. Ohio led in the use of scrap in air furnaces, followed in order by Illinois, Pennsylvania, Michigan, Indiana, Wisconsin, and New York.

Consumption of ferrous scrap and pig iron in air furnaces [1] in the United States in 1946, by districts and States, in short tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	8				
Massachusetts	3	39,642	17,227	56,869	18,594
New Hampshire	1				
Total: 1946	12	39,642	17,227	56,869	18,594
1945	12	38,923	14,461	53,384	23,079
Middle Atlantic:					
Delaware	1				
New Jersey	2	14,150	2,693	16,843	8,211
New York	9	28,775	12,612	41,387	19,460
Pennsylvania	24	92,251	48,299	140,550	53,344
Total: 1946	36	135,176	63,604	198,780	81,015
1945	40	152,071	67,876	219,947	96,645
Southeastern and Southwestern:					
West Virginia	2				
Texas	1	14,027	10,457	24,484	6,089
Total: 1946	3	14,027	10,457	24,484	6,089
1945	3	14,416	10,360	24,776	23,819
North Central:					
Illinois	12				
Indiana	9	177,422	84,119	261,541	94,393
Michigan	7	76,267	29,629	105,896	33,171
Iowa	1				
Kansas	1				
Minnesota	1	11,738	4,833	16,571	9,987
Missouri	1				
Ohio	23	195,992	86,351	282,343	85,334
Wisconsin	11	41,657	19,667	61,324	25,416
Total: 1946	66	503,076	224,599	727,675	248,301
1945	66	532,823	235,542	768,365	287,719
Rocky Mountain and Pacific Coast:					
Colorado	1				
California	2	2,588	708	3,296	2,437
Total: 1946	3	2,588	708	3,296	2,437
1945	4	2,863	589	3,452	2,691
Total United States: 1946	120	694,509	316,595	1,011,104	356,436
1945	125	741,096	328,828	1,069,924	433,953

[1] Includes 2 Brackelsberg furnaces, 1 each in Indiana and Ohio.

Crucible and Puddling Furnaces.—Crucible furnaces used 2,021 short tons of scrap and 985 tons of pig iron in 1946 compared with 797 and 552 tons, respectively, in 1945. Puddling furnaces used 17,741 tons of scrap and pig iron, a drop of 42 percent from 1945. Of the total puddling-furnace melt in 1946, 3,235 tons were scrap compared with 7,824 tons during the previous year. The bulk of the consumption was in Kentucky, whereas in 1945 Pennsylvania was the largest consuming State.

Consumption of ferrous scrap and pig iron in crucible and puddling furnaces in the United States in 1946, by districts and States in short tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	1				
Massachusetts	2	771	1,087	1,858	629
New Hampshire	1				
Total: 1946	4	771	1,087	1,858	629
1945	4	334	299	633	288
Middle Atlantic and Southeastern:					
District of Columbia	1				
New Jersey	1	4	2,172	2,176	8,286
Kentucky	1				
Pennsylvania	5	19	1,098	1,117	6,273
Total: 1946	8	23	3,270	3,293	14,559
1945	13	917	7,008	7,925	22,801
North Central:					
Ohio	1	(1)	(1)	(1)	(1)
Wisconsin	1				
Total: 1946	2	(1)	(1)	(1)	(1)
1945	1				
Southwestern and Pacific Coast:					
Oklahoma	1	(1)	(1)	(1)	(1)
California	1				
Total: 1946	2	(1)	(1)	(1)	(1)
1945	2				
Total United States: 1946	16	855	4,401	5,256	15,491
1945	20	1,284	7,337	8,621	23,277

[1] Included with total for United States.

Blast Furnaces.—Materials other than scrap constitute by far the largest proportion of the blast-furnace charge and in 1946 consisted of 68,583,881 short tons of iron and manganiferous ores, 11,837,506 tons of sinter, 2,621,570 tons of mill cinder and roll scale, 3,043,713 tons of open-hearth and Bessemer slag, 74,803 tons of raw flue dust, and 38,101 tons of miscellaneous materials.

Total consumption of scrap in 1946, as reported by 68 plants operating blast furnaces, was 2,272,938 short tons, a 32-percent decrease from 1945. These figures do not include 8,242 tons of home and 10,039 tons of purchased scrap used in blast furnaces in the manufacture of ferro-alloys. The scrap charged to blast furnaces was divided into 51 percent home and 49 percent purchased, compared to 39 and 61 percent, respectively, in 1945 and 1944. The proportion of scrap used to pig iron produced was 5.1 percent compared with 6.3 percent in 1945; purchased scrap accounted for 2.5 percent and home scrap 2.6 percent in 1946.

Consumption of ferrous scrap in blast furnaces [1] in the United States in 1946, by districts and States, in short tons

District and State	Active plants reporting	Scrap		
		Home	Purchased	Total
New England and Middle Atlantic:				
Massachusetts	1	21,604	38,508	60,112
New York	6			
Pennsylvania	17	456,150	305,174	761,324
Total: 1946	24	477,754	343,682	821,436
1945	25	592,946	772,553	1,365,499
Southeastern:				
Alabama	5	167,233	68,983	236,216
Kentucky	1			
Maryland	1			
Tennessee	1	59,988	93,238	153,226
West Virginia	2			
Total: 1946	10	227,221	162,221	389,442
1945	12	217,565	415,726	633,291
North Central:				
Illinois	6	99,345	114,746	214,091
Indiana	3	27,977	14,552	42,529
Michigan	2			
Minnesota	2	66,848	85,083	151,931
Ohio	17	218,182	382,747	600,929
Total: 1946	30	412,352	597,128	1,009,480
1945	32	471,541	855,029	1,326,570
Rocky Mountain and Pacific Coast:				
Colorado	1			
Utah	2	51,263	1,317	52,580
California	1			
Total: 1946	4	51,263	1,317	52,580
1945	5	7,485	5,832	13,317
Total United States: 1946	68	1,168,590	1,104,348	2,272,938
1945	74	1,289,537	2,049,140	3,338,677

[1] Does not include scrap used for the production of ferro-alloys.

USE OF SCRAP IN FERRO-ALLOY PRODUCTION

The production of ferro-alloys in 1946 consumed 275,850 short tons of scrap, a 12-percent decrease from 1945. Purchased scrap accounted for 94 percent of the quantity used and home scrap 6 percent—the same percentages as in 1945.

Twenty ferro-alloy plants used ferrous scrap in 1946 compared with 21 in 1945. Of the scrap consumed in this industry, 4 percent was used in blast furnaces and 96 percent in electric furnaces; and 253 tons were used in the aluminothermic process.

Of the 20 ferro-alloy plants which used iron and steel scrap in 1946, 3 operated blast furnaces and 17 employed electric furnaces. One of the latter group also used the aluminothermic process.

Consumption of ferrous scrap by ferro-alloy producers in the United States in 1946, by districts and States, in short tons

District and State	Active plants reporting	Scrap		
		Home	Purchased	Total
Middle Atlantic:				
New York	6	74	74,542	74,616
Pennsylvania	2		469	469
Total: 1946	8	74	75,011	75,085
1945	8	498	72,521	73,019
North Central:				
Iowa	1	17,022	127,612	144,634
Ohio	4			
Total: 1946	5	17,022	127,612	144,634
1945	6	18,580	134,743	153,323
Southeastern:				
Alabama	1			
South Carolina	1			
Tennessee	1		50,976	50,976
West Virginia	1			
Total: 1946	4		50,976	50,976
1945	4	10	75,596	75,606
Pacific Coast:				
California	1			
Oregon	1		5,155	5,155
Washington	1			
Total: 1946	3		5,155	5,155
1945	3		9,847	9,847
Total United States: 1946	20	17,096	258,754	275,850
1945	21	19,088	292,707	311,795

MISCELLANEOUS USES

As in 1945, slightly less than 2 percent of the 1946 consumption of scrap was for miscellaneous purposes, such as rerolling, in nonferrous metallurgy, and as a chemical agent. The quantity so used—977,703 short tons—was an increase of 2 percent over that used for these purposes in 1945. Of the quantity used, 94 percent was purchased and 6 percent home scrap.

Consumption of ferrous scrap in miscellaneous uses in the United States in 1946, by districts and States, in short tons

District and State	Active plants reporting	Scrap		
		Home	Purchased	Total
New England:				
Massachusetts	3	912	12,022	12,934
Connecticut	1			
Total: 1946	4	912	12,022	12,934
1945	5	28	11,671	11,699
Middle Atlantic:				
New Jersey	16	3,685	106,899	110,584
New York	11	1,366	93,362	94,728
Pennsylvania	20	27,794	107,162	134,956
Total: 1946	47	32,845	307,423	340,268
1945	54	30,868	254,916	285,784
Southeastern:				
Alabama	3	91	32,868	32,959
Georgia	2	554	848	1,402
Tennessee	1			
Maryland	1	487	59,933	60,420
Virginia	2			
West Virginia	1			
Total: 1946	10	1,132	93,649	94,781
1945	11	1,877	98,847	100,724
Southwestern:				
Louisiana	2	289	24,450	24,739
Texas	3			
Total: 1946	5	289	24,450	24,739
1945	5	242	32,364	32,606
North Central:				
Illinois	8	1,781	199,722	201,503
Indiana	3	12,813	10,446	23,259
Michigan	2	2,760	34,399	37,159
Nebraska	1			
Wisconsin	2			
Minnesota	2	250	582	832
Missouri	4	----------	29,401	29,401
Ohio	8	137	83,238	83,375
Total: 1946	30	17,741	357,788	375,529
1945	33	22,520	362,738	385,258
Rocky Mountain:				
Arizona	5	2	35,458	35,460
Nevada	2			
New Mexico	2			
Colorado	2	661	16,273	16,934
Idaho	1			
Montana [1]	3			
Utah	6	1,263	24,031	25,294
Total: 1946	21	1,926	75,762	77,688
1945	21	2,834	109,039	111,873
Pacific Coast:				
California	9	434	49,455	49,889
Oregon	1	----------	1,875	1,875
Washington	3			
Total: 1946	13	434	51,330	51,764
1945	15	414	33,431	33,845
Total United States: 1946	130	55,279	922,424	977,703
1945	144	58,783	903,006	961,789

[1] In addition, 1,191 tons of pig iron were consumed in miscellaneous uses in Montana during 1946.

STOCKS

Complete iron and steel-scrap stock figures covering 1946 year-end stocks are not available; producers (railroads and manufacturers) were not canvassed. Dealers and automobile wreckers reporting to the Bureau of Mines had 398,020 short tons of materials on hand December 31, 1946, compared with 720,201 short tons at the end of 1945, a decrease of 322,181 short tons or 45 percent. A special canvass of all dealers in October 1946 revealed that the dealers reporting regularly held approximately 78 percent of the stocks. The dealers not reporting regularly indicated that their stocks had shown a decline at that time. Therefore, it is evident that stocks of all suppliers decreased for the year. Total stocks of iron and steel scrap on hand December 31, 1946 (exclusive of producers), totaled 3,795,441 short tons, representing a decrease for the fourth consecutive year.

Most of the decrease in 1946 was due to the 45-percent drop in suppliers' stocks and a 20-percent decrease in consumers' stocks of purchased scrap. There was virtually no change in home-scrap stocks at the end of 1946 from those at the end of 1945, as most of this is recycled material which is recharged continuously.

Consumers' Stocks.—Consumers' stocks of home and purchased iron and steel scrap on December 31, 1946, totaled 3,397,421 short tons—a decrease of 526,782 short tons or 13 percent from the beginning of the year. Stocks of home scrap (1,230,276 tons) were virtually unchanged, but purchased scrap (2,167,145 tons) decreased 20 percent. Stocks of pig iron on December 31, 1946 amounted to 915,168 short tons, a 26-percent decrease from the 1,237,058 tons on hand December 31, 1945.

Suppliers' Stocks.—Stocks of iron and steel scrap in the hands of dealers (387,104 tons) and automobile wreckers (10,916 tons) totaled 398,020 short tons on December 31, 1946, compared with 720,201 tons on December 31, 1945—a drop of 45 percent.

Consumers' stocks of ferrous scrap and pig iron on hand in the United States on Dec. 31, 1945, and Dec. 31, 1946, by States and districts, in short tons

State and district	Dec. 31, 1945				Dec. 31, 1946			
	Scrap			Pig iron	Scrap			Pig iron
	Home	Purchased	Total		Home	Purchased	Total	
Connecticut	5,011	21,683	26,694	18,613	6,029	11,596	17,625	8,917
Maine	1,289	1,779	3,068	2,334	159	3,443	3,602	1,312
Massachusetts	15,015	35,925	50,940	26,980	11,022	37,530	48,552	19,311
New Hampshire	515	1,035	1,550	1,281	297	2,698	2,995	612
Rhode Island	699	2,988	3,687	5,239	744	3,741	4,485	1,367
Vermont	597	3,199	3,796	1,396	416	3,903	4,319	886
Total New England	23,126	66,609	89,735	55,843	18,667	62,911	81,578	32,405
Delaware	23,042	73,034	96,076	33,458	14,785	62,642	77,427	19,457
New Jersey								
New York	54,134	168,579	222,713	58,009	67,823	96,042	163,865	64,940
Pennsylvania	472,546	461,511	934,057	302,262	436,222	403,228	839,450	247,940
Total Middle Atlantic	549,722	703,124	1,252,846	393,729	518,830	561,912	1,080,742	332,337
Alabama	46,032	94,753	140,785	66,745	27,892	34,382	62,274	50,107
District of Columbia	57,984	74,546	132,530	25,172	42,488	32,980	75,468	28,010
Kentucky								
Maryland								
Florida	1,564	28,068	29,632	5,232	1,528	11,981	13,509	4,766
Georgia								
Mississippi	101	182	283	377	153	201	354	232
North Carolina	132	1,406	1,538	2,889	137	1,842	1,979	2,197
South Carolina	66	3,576	3,642	1,649	121	1,502	1,623	1,047
Tennessee	4,987	34,656	39,643	14,932	4,424	32,952	37,376	13,064
Virginia								
West Virginia	6,334	59,536	65,870	31,039	4,232	41,320	45,552	11,710
Total Southeastern	117,200	296,723	413,923	148,035	80,975	157,160	238,135	111,133
Arkansas	1,609	8,947	10,556	1,044	735	9,201	9,936	926
Louisiana								
Oklahoma								
Texas	2,698	47,905	50,603	13,422	2,074	26,530	28,604	4,847
Total Southwestern	4,307	56,852	61,159	14,466	2,809	35,731	38,540	5,773
Illinois	112,375	391,471	503,846	113,915	91,811	305,207	397,018	71,597
Indiana	86,323	144,560	230,883	52,138	72,553	123,874	196,427	46,708
Iowa	3,324	20,333	23,657	15,665	4,323	28,566	32,889	4,588
Kansas	1,341	12,892	14,233	1,408	775	16,946	17,721	706
Nebraska								
Michigan	50,276	198,347	248,623	135,726	117,123	199,714	316,837	101,866
Wisconsin								
Minnesota	8,427	29,598	38,025	13,748	6,852	25,789	32,641	4,977
Missouri	3,629	57,114	60,743	7,402	1,915	41,259	43,174	4,515
North Dakota	387	127	514	111	311	60	371	84
South Dakota								
Ohio	176,992	369,799	546,791	171,960	235,723	357,762	593,485	154,243
Total North Central	443,074	1,224,241	1,667,315	512,073	531,386	1,099,177	1,630,563	389,284
Arizona	2,266	13,019	15,285	147	1,949	12,392	14,341	
Nevada								
New Mexico								
Colorado	40,698	105,068	145,766	46,718	25,685	63,833	89,518	15,490
Utah								
Idaho	1	3,248	3,249	95	4	2,440	2,444	52
Wyoming	4	1	5	7	3	1	4	6
Montana	2,118	11,442	13,560	185	2,386	10,482	12,868	295
Total Rocky Mountain	45,087	132,778	177,865	47,152	30,027	89,148	119,175	16,131
Alaska	4,576	73,591	78,167	4,255	4,220	48,405	52,625	2,321
Oregon								
Washington								
California	31,401	151,792	183,193	61,505	43,362	112,701	156,063	25,784
Total Pacific Coast	35,977	225,383	261,360	65,760	47,582	161,106	208,688	28,105
Total United States	1,218,493	2,705,710	3,924,203	1,237,058	1,230,276	2,167,145	3,397,421	915,168

FOREIGN TRADE[1]

Imports.—Imports of iron and steel scrap in 1946 decreased 35 percent in quantity (30,228 short tons compared with 46,271 tons in 1945) and 52 percent in value ($266,733 compared with $555,471 in 1945). Of the 1946 imports, 10,512 tons came from Canada, 7,451 from Venezuela, 5,573 from Curaçao, 2,807 from Jamaica, 2,487 from Cuba, and the remainder in small tonnages from other countries. In addition, 27,473 tons of tin-plate scrap were imported (25,911 tons from Canada) compared with 20,240 tons in 1945.

Exports.—Exports of ferrous scrap from the United States in 1946 were 149,106 short tons valued at $3,384,514, a 56-percent increase in tonnage over 1945 and a 31-percent increase in value. Exports exceeded imports by 118,878 short tons (not counting 27,473 tons of imported tin-plate scrap). The tonnage exported amounted to 5 percent of the 5-year prewar average (for 1935–39) of 3,298,326 tons a year, compared with 3 percent during 1945. The high domestic requirement for scrap and the continued shortage of scrap are the reasons for the continued low level of exports. The 1946 exports included 12,826 tons of tin-plate scrap, circles, strips, cobbles, and waste and terne-plate clippings and scrap valued at $1,052,160. The same materials in 1945 amounted to 16,475 tons valued at $1,359,360. The accompanying table shows the principal countries to which scrap was exported during the period 1942–46.

Ferrous scrap exported from the United States, 1942–46, by countries, in short tons

Country	1942	1943	1944	1945	1946
Argentina	2,888		87	4,264	4,630
Brazil			271	1,088	787
Canada	121,471	34,085	71,518	47,465	82,346
Chile	203	615	72	7,447	1,334
China				112	7,930
Colombia	366	155	1,819	955	22
Cuba	93	1		687	521
Hong Kong					649
Mexico	15,502	18,157	17,509	27,471	48,194
Philippines, Republic of					240
Sweden				510	493
Union of South Africa		461		168	393
United Kingdom	142	115		199	435
Uruguay			220	4,432	425
Other countries	1,071	1,305	4,186	936	707
Total: Short tons	141,736	54,894	95,682	95,734	149,106
Value	$3,321,523	$1,070,809	$1,910,226	$2,589,239	$3,384,514

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

WORLD REVIEW

Eire.—The small steel operations of the Irish Steel Co., Ltd., were not resumed until July 1946, when the first 35-ton open-hearth furnace was put into operation, and it was not until late in the year that indications showed that a substantial part of the capacity of 5,000 tons would soon be utilized.[2]

The scrap supply in Eire is protected by an export regulation which gives Irish industry the option of purchase on all scrap before it may be exported. Therefore, scrap producers must inform plants of scrap available, and if it is required by industry it cannot be exported. Opinions vary as to the quantity of scrap available in Eire. Some estimates are as high as 30,000 tons per year, while others indicate that Eire may have to import some scrap for future domestic requirements.

France.—It was reported in August that during the following 12 months France was to supply Belgium and Luxembourg with 15,000 tons of scrap iron from North Africa.[3]

Japan.—Previous to World War II, Japan used more than 50 percent scrap in its open-hearth furnaces. This requirement for scrap was covered by heavy imports from the United States and other countries. To make the Japanese industry less dependent on foreign sources for scrap the Japanese Government in 1937 and 1938 took steps to force the industry to increase the proportion of pig to scrap in the furnace charge. Consequently, the production of pig iron was increased from approximately 1,000,000 metric tons in 1932 to over 4,000,000 tons in 1942, and a goal was set for the use of 70 percent pig iron to 30 percent scrap in the furnace charge. The open-hearth mixture reached approximately 65 percent pig and 35 percent scrap by the end of the war.[4]

United Kingdom.—The supply of iron and steel scrap in the United Kingdom was adequate for most of 1946. However, during the last quarter of the year there were signs of a severe shortening of supplies. The Cleveland district, which had reported adequate supplies as late as October 1946, was having difficulty in supplying steel mills in the latter part of November and during December. Deliveries in South Wales also dropped off during the last 2 months of the year but had been satisfactory earlier. Suppliers seemed able to meet demands for scrap in the Birmingham district throughout the year. Consumers in the Midlands, Lancashire, and Yorkshire were using scrap as fast as it became available. The supply of the better grades of scrap in Scotland was becoming scarce at the close of the year.

[2] Iron Age, vol. 158, No. 14, Oct. 3, 1946, pp. 71–72.
[3] Metal Bulletin (London), No. 3116, Aug. 2, 1946, p. 18.
[4] Iron Age, vol. 158, No. 16, Oct. 17, 1946, pp. 114–125.

Lead[1]

By RICHARD H. MOTE

	PAGE
General summary	665
Salient statistics	666
Labor problems	666
Government regulations	667
Tariff	668
Domestic production	668
Mine production	668
Smelter and refinery production	671
Active lead smelters and refineries	673
Domestic production—Cont.	
Refined lead	673
Antimonial lead	674
Secondary lead	675
Lead pigments	675
Consumption and uses	675
Stocks	677
Prices	678
Foreign trade	682
World review	685

GENERAL SUMMARY

LEAD production from domestic mines dropped 14 percent in 1946 and, for the first time on record, was exceeded by the smelter production of secondary lead. The supply of refined lead available for consumption continued to decline despite an advance in price to an unprecedented 12.55 cents per pound at the year's end. Domestic mine production of lead and refinery output from domestic ores and base bullion declined to the lowest levels since 1935 and 1933, respectively. Total output of refined lead at primary refineries fell 25 percent, and antimonial lead production decreased 11 percent. Imports of lead-bearing materials urgently needed to offset the decreasing domestic mine output dropped to the lowest level since 1939. Outstanding among the many factors that restricted production during the year were prolonged labor strikes at mines, mills, smelters, and refineries; continued labor shortages, which prevented capacity operations at many producing plants; uncertainty regarding extension of the Office of Price Administration and ceiling prices; and the consequent unstable price structure during the month when OPA was inoperative. The national railroad and coal-mine strikes in May, though lesser factors, further retarded domestic lead production.

In contrast to the slump in the domestic output of primary lead, the smelter production of secondary lead—always a substantial source of the heavy metal—increased 8 percent over the 1945 output. Secondary lead recovery in 1946 exceeded the total domestic refined primary lead production by 13 percent and surpassed the domestic mine output of recoverable lead for the first time on record. Consumption of refined lead, which declined 17 percent from 1945, was limited through provisions of Civilian Production Administration General Preference Order M–38 and the general inability of consumers to

[1] This report deals primarily with the smelting, refining, and consuming phases of the industry. For full details of domestic mining operations, see separate reports issued for the various States.

obtain full allocations as allotted by the Civilian Production Administration.

The Government stock pile of refined lead was reduced to 45,493 tons at the end of 1946, approximately two-thirds of the quantity available for allocation at the beginning of the year. Stocks at primary smelters and refineries (physical inventory) gained 9 percent during 1946. Consumers' inventories declined 59 percent from 1945.

Ceiling prices on virtually all commodities, including lead, were removed in November. Other Government controls of the lead industry that were revoked included removal of import restrictions (which had prevented public purchases of foreign lead), the 5-year-old General Preference Order M–38, Lead Chemical Order L–354, and Order L–355 pertaining to use of lead for manufacture of tetraethyl fluid.

Salient statistics of the lead industry in the United States, 1925–29 (average) and 1942–46, in short tons

	1925–29 (average)	1942	1943	1944	1945	1946
Production of refined primary lead:						
From domestic ores and base bullion	660, 525	467, 367	406, 544	394, 443	356, 535	293, 309
From foreign ores and base bullion	123, 104	99, 472	63, 068	70, 320	87, 050	44, 888
	783, 629	566, 839	469, 612	464, 763	443, 585	338, 197
Recovery of secondary lead	280, 000	323, 001	342, 094	331, 416	363, 039	392, 787
Imports: [1]						
Lead in pigs, bars, and old	4, 592	369, 254	244, 510	226, 073	230, 313	114, 706
Lead in base bullion	95, 747	43, 855	4, 583	58	8	125
Lead in ores and matte	40, 096	79, 362	69, 945	93, 570	70, 005	44, 407
Exports of refined pig lead [2]	98, 048	5, 814	13, 261	15, 523	1, 784	700
Refined primary lead apparently shipped to domestic consumers	690, 916	669, 840	777, 661	775, 095	670, 122	477, 686
Estimated consumption of primary and secondary lead	900, 250	1, 043, 000	1, 113, 000	1, 118, 643	1, 051, 602	956, 476
Prices (cents per pound):						
New York:						
Average for year	7. 47	6. 48	6. 50	6. 50	6. 50	8. 11
Quotation at end of year	6. 25	6. 50	6. 50	6. 50	6. 50	12. 55
London average	5. 87	4. 49	4. 49	4. 49	4. 99	8. 63
Mine production of recoverable lead	664, 230	496, 239	453, 313	416, 861	390, 831	335, 475
World smelter production of lead	1, 850, 000	1, 883, 000	1, 736, 000	1, 502, 000	1, 378, 000	1, 285, 300

[1] Data include lead imported for immediate consumption plus material entering the country under bond.
[2] Includes 3,874 tons of foreign lead reexported in 1942, 11,258 tons in 1943, less than 1 ton in 1944, 377 tons in 1945, and 103 tons in 1946, according to records of the U. S. Department of Commerce.

Figure 1 shows trends in the domestic lead industry since 1900.

LABOR PROBLEMS

Most significant among the many labor problems confronting operators during 1946 were the widespread labor strikes at principal mines, mills, smelters, and refineries that paralyzed the industry during the first half of the year. Work stoppages began in Utah on January 21, when approximately 1,300 workers at the mining and smelting operations of the American Smelting & Refining Co. and the United States Smelting, Refining & Mining Co. went on strike following collapse of negotiations for increased wages. Strike conditions spread rapidly; and on February 25 workers in virtually every lead-mining, milling, and smelting operation of the American Smelting & Refining Co. joined in the dispute. Lead-zinc mining and milling

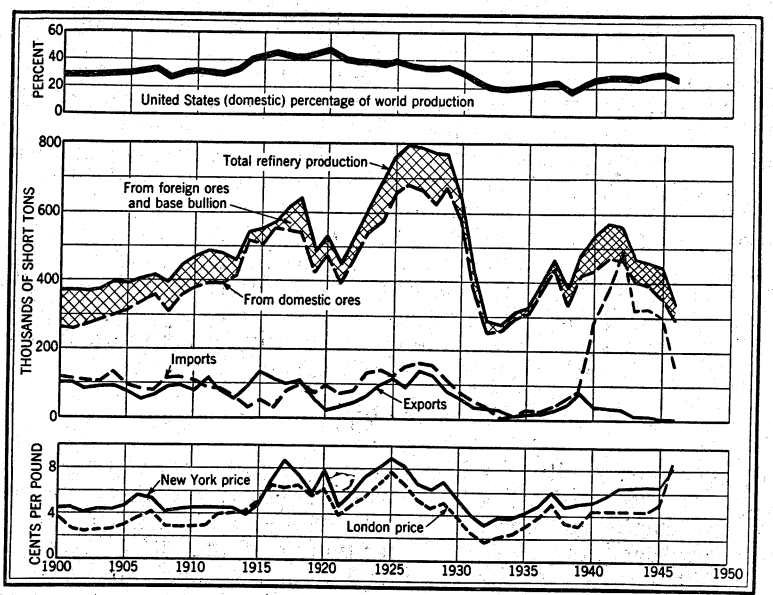

FIGURE 1.—Trends in the lead industry in the United States, 1900–46. Imports include lead in ore, base bullion, pig lead, and scrap; exports include pigs, bars, and scrap lead exported in manufactures with benefit of draw-back. Data on lead exported in manufactures with benefit of draw-back not available for 1945–46.

operations of the Phelps Dodge Corp. at Bisbee, Ariz., were closed by strike on March 20, along with certain of the corporation's Arizona, Texas, and New York copper mining and metallurgical operations. Although the smelter strikes did not materially affect the output of the Nation's large lead mines, many small operations with limited storage facilities and dependent upon prompt payment of smelter returns for operating expenses were forced to close. Virtually all strikes at lead mines, mills, smelters, and refineries were settled by the end of June, although one of brief duration occurred at the mines and mills of the St. Joseph Lead Co. in the Southeastern Missouri districts during the last week in October.

The shortage of mine and mill labor continued to be a potent factor limiting domestic mine output during 1946. The predicted return to the mines of former employees who migrated to the cities for high-paying wartime jobs fell far short of expectations. Likewise, a large percentage of the labor supply that entered the armed services during the war did not return to the mines and mills upon demobilization. The manpower supply problem, however, was considered by most operators to have improved somewhat by the end of 1946.

GOVERNMENT REGULATIONS

Lead continued under Government control during most of 1946 through provisions of Civilian Production Administration General Preference Order M–38. In operation, the order prohibited use of lead for certain purposes but permitted varying freedom in its consumption in essential uses. Several amendments were issued during the year changing quotas (usually to a lower level) of lead permissible

for certain uses. Upon almost unanimous recommendations of the lead producing and consuming industries, the Civilian Production Administration revoked Order M–38 on December 27, thus virtually ending the Government control of lead that began in October 1941.

CPA Limitation Order L–354, affecting the use of lead in the manufacture of lead chemicals, and Order L–355, limiting consumption of lead for tetraethyl lead, were operative until revocation December 27.

Government control on imports of lead as outlined in CPA General Import Order M–63 were eliminated, effective November 18.

Subsidy payments under the Premium Price Plan for overquota production were continued through June but collapsed with the expiration of OPA and ceiling prices June 30. Upon reestablishment of the OPA, provisions were made for retroactive premium payments to cover the period when no plan was in effect.

TARIFF

In accordance with the Mexican Trade Agreement of January 30, 1943, the tariff on lead-bearing ores, flue dust, and mattes remained at three-fourths cent per pound (lead content) and lead bullion, pigs, bars, scrap lead, etc., 1$\frac{1}{16}$ cents per pound during 1946. A provision of the agreement permits the increase in the tariff on lead-bearing ores, flue dust, and mattes to 1$\frac{1}{8}$ cents per pound (lead content), and lead bullion, pigs, bars, scrap lead, etc., to 1$\frac{7}{10}$ cents per pound 30 days after the war emergency is officially terminated.

DOMESTIC PRODUCTION

Statistics on lead output may be prepared on a mine or smelter and refinery basis. The mine-production data compiled on the basis of lead content in ore and concentrates and adjusted to account for average losses in smelting are the most accurate measure of production from year to year. The pig-lead output, as reported by smelters and refiners, presents a more precise figure of actual lead recovery but generally differs from the mine figure due to the overlap or lag between mine shipments and smelter receipts of ore and concentrates. These inequities, however, tend to balance over a period of years.

MINE PRODUCTION

The mine production of recoverable lead (including that made into pigments) from domestic mines in the United States and Alaska decreased 14 percent in 1946, was 32 percent under the war-period peak in 1942, and was 49 percent below the average production in the period 1925 through 1929. The domestic mine production of lead comes principally from three areas—Southeastern Missouri; the Tri-State area (Joplin region), embracing southwestern Missouri, southeastern Kansas, and northeastern Oklahoma; and the Western States (principally Idaho, Utah, Arizona, Colorado, and Montana). Of the total produced in the United States in 1946, about 67 percent came from the output of 25 mines. Missouri again ranked first in the production of lead, and the Southeastern Missouri district continued to be the largest lead-producing area, supplying 40 percent of the total domestic output. The St. Joseph Lead Co. continued,

as in the past, to produce the bulk of the output from its Bonne Terre, Desloge, Federal, and Leadwood groups of mines. Each mine is equipped with a mill; the four have a combined daily capacity of 21,400 tons of ore. The Tri-State area produced 7 percent of the total domestic output in 1946 compared with 6 percent in 1945. The Western States contributed 49 percent of the total domestic production despite a decline of 10 percent from 1945. Idaho continued to be the largest producer of lead in the Western States and second largest in the United States, notwithstanding a production decline of 12 percent and the smallest output of any year since 1899. About 94 percent of the State total lead came from the Coeur d'Alene region. Five properties in Idaho produced 52 percent of the State total lead, and of the total 82 percent came from zinc-lead ore and old tailings from the Coeur d'Alene region. Although lead output in Utah, the lowest since 1899, dropped 25 percent below the 1945 production, the State continued to rank second among the Western States. The United States & Lark property of the United States Smelting, Refining & Mining Co. in the West Mountain (Bingham) district remained first among the State lead producers. About 83 percent of the State total lead was recovered from zinc-lead ore. Lead production in Arizona was the largest in any year in the history of the State and 5 percent greater than in 1945. The Copper Queen mine of the Phelps

Mine production of recoverable lead in the United States, 1925–29 (average) and 1942–46, by States, in short tons

State	1925–29 (average)	1942	1943	1944	1945	1946
Western States and Alaska:						
Alaska	982	415	200	44	11	115
Arizona	9,743	14,772	13,727	16,707	22,867	23,930
California	2,070	5,151	5,820	5,682	7,224	9,923
Colorado	30,112	15,181	18,032	17,698	17,044	17,036
Idaho	141,610	113,909	96,457	83,530	68,447	59,987
Montana	18,871	20,050	16,324	13,105	9,999	8,280
Nevada	9,807	5,376	4,790	6,605	6,275	7,175
New Mexico	6,730	4,608	5,723	7,265	7,662	4,899
Oregon	6	23	4	4	1	2
South Dakota	21	85	41	34		
Texas	213	181	13			47
Utah	149,509	71,930	65,257	52,519	40,817	30,711
Washington	1,323	4,851	5,022	5,825	3,802	2,987
Wyoming		3			3	
Total	370,997	256,535	231,410	209,018	184,152	165,092
Central States:						
Arkansas	38	2	1		1	2
Illinois	552	2,344	2,043	1,971	3,005	3,865
Kansas	26,121	9,419	9,213	9,394	7,370	6,445
Kentucky	135	335	240	170	129	95
Missouri	202,240	199,548	184,910	174,683	176,575	139,112
Oklahoma	58,306	22,806	19,733	13,944	12,664	13,697
Wisconsin	1,745	775	920	1,415	1,776	1,588
Total	289,137	235,229	217,060	201,577	201,520	164,804
Eastern States:						
New York		2,434	2,355	1,644	862	1,073
Tennessee	250	238	200		54	125
Virginia	3,846	1,803	2,288	4,622	4,243	4,381
Total	4,096	4,475	4,843	6,266	5,159	5,579
Grand total	664,230	496,239	453,313	416,861	390,831	335,475

Dodge Corp. at Bisbee continued to be the largest Arizona lead producer in 1946; about 90 percent of the total lead was recovered from zinc-lead ore. Colorado production remained virtually unchanged; the California (Leadville) district continued to be the largest lead-producing area in the State. Zinc-lead ore yielded 54 percent of the State total in 1946.

Mine production of recoverable lead in the United States, by districts that produced 1,000 tons or more during any year, 1942–46, in short tons

District	State	1942	1943	1944	1945	1946
Southeastern Missouri region	Missouri	197,291	179,012	169,622	173,005	135,796
Coeur d'Alene region	Idaho	106,474	89,813	76,813	63,430	56,548
Tri-State (Joplin region)	Kansas, Southwestern Missouri, Oklahoma.	34,341	34,722	28,059	23,556	23,363
West Mountain (Bingham)	Utah	39,996	35,437	31,169	22,723	12,343
Warren (Bisbee)	Arizona	813	712	3,497	9,400	10,889
Park City region	Utah	15,278	16,022	11,660	8,916	8,373
Coso	California	755	2,448	2,609	5,214	7,708
Old Hat	Arizona	1,801	3,140	4,161	5,216	4,731
California (Leadville)	Colorado	3,348	4,950	5,752	5,016	4,441
Austinville	Virginia	1,661	1,760	4,235	4,222	4,381
Tintic	Utah	10,176	8,261	5,319	4,930	4,239
Kentucky-Southern Illinois	Kentucky, Southern Illinois	2,546	2,199	2,048	2,649	3,687
Pioche	Nevada	2,764	2,942	4,056	2,987	3,493
Rush Valley [1]	Utah	3,988	3,505	3,293	3,137	3,490
Animas	Colorado	2,124	2,657	2,236	2,613	3,207
Central	New Mexico	3,206	3,571	4,428	5,379	3,199
Heddleston	Montana	2,290	2,350	2,436	3,175	2,648
Upper San Miguel	Colorado	1,716	2,074	1,442	1,986	2,376
Summit Valley (Butte)	Montana	7,206	3,290	3,251	2,870	2,357
Pima (Sierritas, Papago, Twin Buttes).	Arizona	11	578	2,445	2,063	2,296
Metaline	Washington	4,553	4,581	5,278	3,506	2,224
Pioneer (Rico)	Colorado	2,282	2,566	2,826	2,440	2,176
Big Bug	Arizona	953	1,145	1,244	1,981	2,155
Upper Mississippi Valley	Iowa, Northern Illinois, Wisconsin.	908	1,004	1,508	2,261	1,861
Warm Springs	Idaho	3,783	3,635	3,333	2,347	1,649
Magdalena	New Mexico	864	1,320	1,620	1,243	1,273
Restings Springs	California	4,044	2,938	1,800	1,192	1,233
St. Lawrence County	New York	2,434	2,355	1,644	862	1,073
Harshaw	Arizona	6,132	3,496	2,212	1,066	692
Red Cliff	Colorado	2,240	1,761	1,444	572	690
Bayhorse	Idaho	1,644	1,481	2,069	1,302	553
Eagle	Montana	1,999	1,580	1,128	599	469
Smelter (Lewis and Clark County).	do	1,988	2,389	1,364	223	463
Wallapai	Arizona	1,656	1,392	784	752	369
Montana	Montana	1,025	509	569	438	340
Ophir	Utah	1,623	1,461	365	115	336
Port Hill	Idaho	1,044	316	15	61	44
Barker	Montana	1,712	1,633	56	57	32

[1] Includes production from Smelter district in Utah; Bureau of Mines not at liberty to publish separate figures.

A study of the monthly mine-output figures since January 1941 discloses production trends that are obscure in the annual figures. Output from April through December 1941 remained fairly constant, with a stabilized price of 5.85 cents per pound, New York. Production increased sharply in January 1942, however, as a result of Government action January 13, which established the ceiling price of lead at 6.50 cents, New York. Peak monthly output of 45,305 short tons was reached in March. Labor shortages at mines, mills, and smelters developed rapidly thereafter owing largely to the lure of high wages at Government construction projects and expanded war industries and to the absorption of personnel by the armed forces. Despite an

Army furlough in October 1942 of 4,000 soldiers for service in the mines and the financial assistance available to producers through provisions of the Government's Premium Price Plan which became effective February 1, 1942, mine production declined steadily, almost without exception, through the remainder of 1942 and the following 3 years. Production declined even more precipitously during the first half of 1946 as a result of widespread labor strikes. Except for 1933, the domestic mine output in June was lower than the average monthly production of any year since the beginning of annual records in 1907.

Mine production of recoverable lead in the United States, 1941–46, by months, in short tons [1]

Month	1941	1942	1943	1944	1945	1946
January	[2] 37,627	44,182	37,265	38,656	34,830	32,475
February	[2] 37,627	42,946	36,286	37,982	31,567	29,442
March	[2] 37,627	45,305	40,052	39,272	35,229	30,298
April	38,197	44,318	39,180	37,753	33,592	28,108
May	39,078	43,301	37,868	36,352	35,346	25,555
June	38,099	42,238	36,873	33,733	31,944	23,269
July	36,829	41,770	36,488	29,554	30,717	25,050
August	36,872	39,821	38,280	35,727	30,805	28,641
September	37,769	37,834	36,654	31,522	29,947	27,250
October	39,503	38,191	38,111	31,987	32,942	26,198
November	40,423	37,065	37,524	32,158	32,007	28,860
December	41,775	39,268	38,732	32,165	31,905	30,329
Total	461,426	496,239	453,313	416,861	390,831	335,475

[1] Monthly data for 1941–44 were based largely on smelter receipts, whereas those for 1945 and 1946 represent actual mine output. All monthly figures have been adjusted to final annual mine production totals.
[2] Monthly average for first quarter; actual monthly figures not available.

The 25 leading lead-producing mines in the United States in 1946, listed in the following table, yielded 67 percent of the total domestic lead output; the 6 leading mines produced 42 percent and the 9 leading mines 50 percent.

Detailed information on the production of mines and districts in the United States may be found in the chapters of this volume dealing with the mine production of gold, silver, copper, lead, and zinc in the various States.

SMELTER AND REFINERY PRODUCTION

Pig lead in the United States is derived from three main sources—domestic mine production, imports of foreign ore and base bullion, and secondary smelter output from scrap material—and is produced at primary plants that treat ore, base bullion, and small quantities of scrap and at secondary plants that process scrap exclusively. Of the eight primary smelters operating in the Western States, only two (Selby, Calif., and Bradley, Idaho) produce refined merchant lead. The other six plants produce only base bullion (containing approximately 98 percent lead plus gold, silver, and small quantities of impurities recovered from the ore smelted), which is shipped to refineries in the Middle Western and Eastern States for recovery of the gold and silver and purification of the lead to meet commercial requirements. Both primary and secondary smelting plants may make

25 leading lead-producing mines in the United States in 1946, in order of output

Rank	Mines	District	State	Operator	Type of ore
1	Federal	Southeastern Missouri	Missouri	St. Joseph Lead Co	Lead.
2	Leadwood	do	do	do	Do.
3	Desloge	do	do	do	Do.
4	Bonne Terre	do	do	do	Do.
5	United States and Lark	West Mountain (Bingham)	Utah	U. S. Smelting, Refining & Mining Co	Zinc-lead.
6	Copper Queen	Warren (Bisbee)	Arizona	Phelps Dodge Corp	Do.
7	Bunker Hill and Sullivan	Yreka	Idaho	Bunker Hill & Sullivan Mining & Concentrating Co	Do.
8	Darwin group	Coso	California	Anaconda Copper Mining Co	Lead.
9	Mine La Motte	Southeastern Missouri	Missouri	St. Joseph Lead Co	Do.
10	Page	Yreka	Idaho	Federal Mining & Smelting Co	Zinc-lead.
11	Star	Hunter	do	Sullivan Mining Co	Do.
12	Mammoth-Collins	Old Hat	Arizona	St. Anthony Mining & Development Co	Do.
13	Osburn Tailings	Evolution	Idaho	Hecla Mining Co	Do.
14	Morning	Hunter	do	Federal Mining & Smelting Co	Do.
15	Austinville	Wythe County	Virginia	New Jersey Zinc Co	Do.
16	Park Galena and Mayflower	Blue Ledge	Utah	New Park Mining Co	Do.
17	Madison	Southeastern Missouri	Missouri	St. Louis Smelting & Refining Co	Lead-copper.
18	Sweeny mill tailings	Yreka	Idaho	Bunker Hill & Sullivan Mining & Concentrating Co	Zinc-lead.
19	Ruth	Southeastern Missouri	Missouri	Park City Consolidated Mines Co	Lead.
20	Chief, Gemini, etc	Tintic	Utah	Chief Consolidated Mining Co	Zinc-lead.
21	Combined Metals group	Ploche	Nevada	Combined Metals Reduction Co. & R. E. West Mining Co	Do.
22	Mike Horse and Klienschmidt	Heddleston	Montana	Mike Horse Mining & Milling Co	Do.
23	Resurrection	California (Leadville)	Colorado	Resurrection Mining Co	Do.
24	West Calumet	Rush Valley	Utah	Combined Metals Reduction Co	Do.
25	Park Utah	Uintah	do	Park Utah Consolidated Mining Co	Do.

refined lead or antimonial lead. Because of the large quantity of hard lead—such as battery scrap—melted at secondary smelters, the output from this type of operation is essentially antimonial lead alloys. Statistics on the production of refined lead and alloys at secondary plants are given in the Secondary Lead section of this chapter. The 16 primary smelters and refineries in operation in the United States in 1946 consumed 353,197 short tons (lead content) of ore and concentrates, 12 percent of which was of foreign origin, compared with 454,778 tons in 1945, 19 percent of which was foreign.

ACTIVE LEAD SMELTERS AND REFINERIES

Primary lead smelters and refineries operating in the United States in 1946 were as follows:

California: Selby—Selby plant, American Smelting & Refining Co. (smelter and refinery).
Colorado: Leadville—Arkansas Valley plant, American Smelting & Refining Co. (smelter).
Idaho: Bradley—Bunker Hill Smelter (smelter and refinery).
Illinois: Alton—Federal plant, American Smelting & Refining Co. (smelter and refinery).
Indiana:
East Chicago—International Smelting & Refining Co. (refinery). Purchased by the Eagle-Picher Co., September 27, 1946.
East Chicago—U. S. S. Lead Refinery, Inc. (refinery).
Kansas: Galena—Galena plant, Eagle-Picher Co. (smelter and refinery).
Missouri: Herculaneum—Herculaneum plant, St. Joseph Lead Co. (smelter and refinery).
Montana: East Helena—East Helena plant, American Smelting & Refining Co. (smelter).
Nebraska: Omaha—Omaha plant, American Smelting & Refining Co. (refinery).
New Jersey:
Barber—Perth Amboy plant, American Smelting & Refining Co. (smelter and refinery).
Carteret—United States Metals Refining Co. (refinery).
Texas: El Paso—El Paso plant, American Smelting & Refining Co. (smelter).
Utah:
Midvale—Midvale plant, United States Smelting, Refining & Mining Co. (smelter).
Murray—Murray plant, American Smelting & Refining Co. (smelter).
Tooele—Tooele plant, International Smelting & Refining Co. (smelter).

REFINED LEAD

Primary refineries in the United States in 1946 produced 346,210 short tons of refined lead, a decline of 25 percent from the 1945 output of 462,110 tons.

Of the 338,197 tons of primary lead produced in 1946, domestic ores and base bullion supplied 87 percent and foreign ores and imported base bullion 13 percent. In 1945 the origin was 80 percent domestic and 20 percent foreign. The quantity of refined lead produced from foreign base bullion has been negligible since 1943. The following tables give the production of refined lead by sources and by country of origin of the ore. Details of the sources of lead from domestic ores are given in the Mine Production Section of this chapter.

Refined lead produced at primary refineries in the United States, by sources, 1942–46, in short tons

Source	1942	1943	1944	1945	1946
Refined lead:					
From domestic ores and base bullion	467,367	406,544	394,443	356,535	293,309
From foreign ores	81,485	62,936	70,225	86,932	44,790
From foreign base bullion	17,987	132	95	118	98
Total from primary sources	566,839	469,612	464,763	443,585	338,197
From scrap	12,856	1,863	11,368	18,525	8,013
Total refined lead	579,695	471,475	476,131	462,110	346,210
Average sales price per pound	$0.063	$0.064	$0.064	$0.064	$0.084
Total calculated value of primary refined lead [1]	$71,422,000	$60,110,000	$59,490,000	$56,778,880	$56,817,096

[1] Excludes value of refined lead produced from scrap at primary refineries.

Refined primary lead produced in the United States, by country of origin, 1942–46, in short tons

Source	1942	1943	1944	1945	1946
Domestic ore and base bullion	467,367	406,544	394,443	356,535	293,309
Foreign ore:					
Australia	19,638	16,180	22,210	22,087	7,534
Canada	5,980	4,537	7,461	11,151	5,026
Europe	14				
Mexico	2,403	2,213	5,250	3,097	2,056
South America	23,127	9,610	13,434	25,701	11,344
Other foreign	30,323	30,396	21,870	24,896	18,830
Total	81,485	62,936	70,225	86,932	44,790
Foreign base bullion:					
Australia	16,902				
Mexico	111	60	58	63	10
South America	216	72	37	55	88
Other foreign	758				
Total	17,987	132	95	118	98
Total foreign	99,472	63,068	70,320	87,050	44,888
Grand total	566,839	469,612	464,763	443,585	338,197

ANTIMONIAL LEAD

Antimonial lead production at primary refineries dropped to 50,480 tons in 1946, 11 percent under the 1945 output. The distribution of the lead, according to source, is shown in the following table. The quantity of antimony contained in antimonial lead produced in 1946 dropped to 6.5 percent owing to a greater demand for low-percentage alloys for use in the manufacture of such items as type metal, cable covering, sheet and pipe, and collapsible tubes and foil. Although antimonial lead is an important byproduct of the refining of base bullion, the quantity derived from this source is only a small part of the annual domestic output. The major production is recovered from the smelting of antimonial lead scrap at secondary smelters. Production data from lead-smelting plants treating scrap materials exclusively are summarized in the following section and discussed in detail in the Secondary Metals—Nonferrous chapter of this volume.

Antimonial lead produced at primary lead refineries in the United States, 1942–46

Year	Production (short tons)	Antimony content		Lead content by difference (short tons)			
		Short tons	Percent	From domestic ore	From foreign ore	From scrap	Total
1942	51,762	3,524	6.8	24,512	12,165	11,561	48,238
1943	63,515	3,371	5.3	16,674	10,583	32,887	60,144
1944	57,902	4,670	8.1	13,280	5,477	34,475	53,232
1945	56,495	4,148	7.3	7,286	2,695	42,366	52,347
1946	50,480	3,285	6.5	11,196	2,149	33,850	47,195

SECONDARY LEAD

Some scrap lead is treated at primary smelters and refineries, but the greater part is received at a large number of plants that treat secondary materials exclusively. Secondary lead is recovered in the form of refined lead, antimonial lead, and other alloys. Recovery at primary and other plants in 1942–46 is shown in the following table. Secondary lead recovery in 1946 exceeded the total domestic refined primary lead production by 13 percent and surpassed the domestic mine output of recoverable lead for the first time on record. Further details appear in the Secondary Metals—Nonferrous chapter of this volume.

Secondary lead recovered in the United States, 1942–46, in short tons

	1942	1943	1944	1945	1946
As refined metal:					
At primary plants	12,856	1,863	11,368	18,525	8,013
At other plants	55,746	56,459	43,678	42,598	65,691
Total	68,602	58,322	55,046	61,123	73,704
In antimonial lead:					
At primary plants	11,561	32,887	34,475	42,366	33,850
At other plants	158,998	144,040	146,343	151,713	159,834
Total	170,559	176,927	180,818	194,079	193,684
In other alloys	83,840	106,845	95,552	107,837	125,399
Grand total:					
Short tons	323,001	342,094	331,416	363,039	392,787
Value	$40,698,100	$43,788,000	$42,421,248	$46,468,992	$65,988,216

LEAD PIGMENTS

The principal lead pigments are litharge, white lead, red lead, sublimed lead, leaded zinc oxide, and orange mineral. These products are manufactured for the most part from metal, but some ore and concentrates are converted directly to pigments. Details of the production of lead pigments are given in the Lead and Zinc Pigments and Zinc Salts chapter of this volume.

CONSUMPTION AND USES

A survey of 575 plants in 1946 representing an estimated 98 percent of the consumers of refined lead indicated a total consumption of 530,588 short tons of refined lead, a decrease of 17 percent from 1945. Some secondary as well as primary refined lead is included in this

figure. Antimonial lead, unrefined scrap lead, and lead in alloys are excluded. Of the total consumed, 24 percent was used for making red lead and litharge; 13 percent for cable covering; 11 percent for storage batteries; 9 percent for tetraethyl fluid; 8 percent for white lead; 6 percent for solder; 5 percent for pipes, traps, and bends; 5 percent for sheet lead; 3 percent for ammunition; and 16 percent for a variety of products and uses shown in the following table. A distribution of the total consumed by related uses indicates 51 percent consumed for metallic products, 32 percent for pigments, 11 percent in chemical products, and 6 percent in miscellaneous uses, such as annealing, galvanizing, lead plating, and weights and ballast.

Reports to the Civilian Production Administration indicated a consumption of 956,476 tons of primary, antimonial, and secondary lead in 1946 compared with 1,051,602 tons in 1945.

Consumption of refined lead in the United States, 1942–46, by uses, in short tons

	1942	1943	1944	1945	1946
Ammunition	48,025	64,023	31,479	29,315	16,857
Bearing metals	8,466	10,189	15,941	14,104	11,012
Brass and bronze	5,294	5,748	7,845	7,069	5,328
Cable covering	128,535	117,802	110,417	86,158	69,004
Calking lead	9,047	8,618	9,411	13,374	8,314
Casting metals	3,106	3,072	4,425	5,322	3,566
Collapsible tubes	9,966	11,425	12,482	7,428	7,189
Foil	9,359	5,816	11,190	2,185	2,143
Pipe, traps, and bends	21,411	18,724	24,387	24,061	27,372
Sheet lead	31,700	27,738	31,546	30,624	26,430
Solder	13,371	15,472	22,390	27,475	32,279
Storage batteries	62,604	68,239	68,769	60,179	56,726
Terneplate	2,336	815	2,190	2,178	1,526
Type metals	943	812	1,269	1,401	1,487
White lead	56,476	36,809	54,333	35,611	43,294
Red lead and litharge	100,563	124,715	157,080	157,171	128,513
Tetraethyl lead	50,152	65,320	83,067	75,890	47,965
Chemicals and insecticides	6,298	8,172	10,703	8,567	8,169
Annealing	5,229	5,987	5,719	5,525	5,514
Galvanizing	484	819	1,073	988	1,132
Lead plating	(1)	941	494	1,130	1,182
Weights and ballast	(1)	9,269	22,964	9,539	3,089
Other	33,746	64,940	33,646	32,205	22,497
Total	607,111	675,465	722,820	637,499	530,588

[1] Included under "Other".

The following table shows the calculated apparent shipments of refined primary lead to domestic consumers. The apparent shipments of 477,686 tons in 1946 are probably more nearly correct than the actual receipts of 459,502 tons reported by consumers, because of incomplete coverage of the survey.

Apparent shipments of refined primary pig lead to domestic consumers, 1942–46, in short tons

	1942	1943	1944	1945	1946
Supply:					
Stocks at primary refineries on Jan. 1	[1] 12,000	39,255	36,464	16,788	[2] 37,691
Government-owned stocks on Jan. 1 [3]	17,934	248,361	173,875	90,454	68,700
Production	566,839	469,612	464,763	443,585	346,210
Imports	366,497	244,033	222,758	227,469	112,241
Total available	963,270	1,001,261	897,860	778,296	564,842
Withdrawn:					
Stocks at primary refineries on Dec. 31	39,255	36,464	16,788	37,690	40,963
Government-owned stocks on Dec. 31 [3]	248,361	173,875	90,454	68,700	45,493
Exports [4]	5,814	13,261	15,523	1,784	700
Total withdrawn	293,430	223,600	122,765	108,174	87,156
Apparent shipments to domestic consumers	669,840	777,661	775,095	670,122	477,686

[1] Estimate based upon American Bureau of Metal Statistics data.
[2] Revised figure.
[3] According to reports submitted to the Tin-Lead-Zinc Division of the Civilian Production Administration.
[4] Includes 3,874 tons of foreign refined lead reexported in 1942, 11,258 tons in 1943, less than 1 ton in 1944, 377 tons in 1945, and 103 tons in 1946, according to records of the U. S. Department of Commerce.

STOCKS

Producers' Stocks.—Lead stocks, as reported by the American Bureau of Metal Statistics, are shown in the following table. Stocks of refined and antimonial lead include metal held by all primary refiners and by some of the refiners of secondary material who produce soft lead, plus foreign lead smelted and refined in the United States and entered for domestic consumption. According to monthly reports released by the American Bureau of Metal Statistics, stocks of refined lead and antimonial lead declined erratically from a high of 51,929 tons in February to a low of 31,396 tons in August, after which stocks advanced steadily to a year-end total of 48,499 tons—a net gain of 11 percent from January 1.

Lead stocks at end of year at smelters and refineries in the United States, 1942–46, in short tons

[American Bureau of Metal Statistics]

	1942	1943	1944	1945	1946
Refined pig lead	28,815	28,821	15,602	35,853	41,057
Antimonial lead	6,122	4,269	3,934	7,893	7,442
Total	34,937	33,090	19,536	43,746	48,499
Lead in base bullion—					
At smelters and refineries	7,359	8,640	7,333	8,618	8,453
In transit to refineries	1,706	3,112	3,331	4,889	4,911
In process at refineries	13,925	16,020	14,473	15,097	16,042
Total	22,990	27,772	25,137	28,604	29,406
Lead in ore and matte and in process at smelters	59,247	68,678	80,461	89,462	111,836
Grand total	117,174	129,540	125,134	161,812	189,741

The Bureau of Mines annual survey of primary lead smelters and refiners indicated stocks of 37,691 tons (lead content) of refined lead at plants on January 1, 1946, and 40,963 tons on December 31, 1946. Primary antimonial lead stocks at these same plants decreased from 6,773 short tons (lead content) at the beginning of 1946 to 5,935 tons at the end of the year. In terms of lead content, stocks of ore at the 16 operating smelters and refineries increased 23 percent from 59,095 tons to 72,400 tons during the same period. The inventory of base bullion at refineries that receive base bullion as a raw material and at smelters that produce base bullion for shipment to refineries totaled 7,125 tons at the beginning of January and 7,581 tons at the end of December 1946. Stocks of "in process" base bullion or work lead at five combination smelter-refinery plants are not included in reports to the Bureau of Mines. No direct comparison can be made between these data and the figures of the American Bureau of Metal Statistics. Figures reported to the Bureau of Mines represent physical inventory at the plants, irrespective of ownership, and do not include material in process or in transit.

Consumers' Stocks.—Approximately 575 consumer plants reported stocks of 41,914 tons of domestic and foreign refined lead on hand December 31, 1946, a 59-percent decrease from the 102,937-ton inventory (revised figure) reported at the end of 1945.

Consumers' stocks of refined soft lead at the end of 1945 and 1946, by grades, in short tons

	Domestic and foreign					Foreign (all grades)
	Corroding	Chemical	Common	Other	Total	
Dec. 31, 1945 [1]	33,428	22,040	46,277	1,192	102,937	4,264
Dec. 31, 1946	10,593	9,856	18,777	2,688	41,914	2,986

[1] Revised figures.

Government Stocks.—Industry-owned stocks were augmented by a supply of Government-owned lead stored at strategic points throughout the United States for allocation to consumers as needed. According to reports submitted to the Civilian Production Administration, Government stocks of refined lead (all corroding grade) were 45,493 short tons on December 31, 1946, compared with 68,700 tons of refined lead on January 1, 1946. Of the 45,493 ton inventory at the end of 1946, about 8,400 tons were stored outside the continental United States and approximately 16,000 tons were enroute by boat to east coast ports.

PRICES

The two major markets for lead in the United States are New York and St. Louis; much of the lead produced domestically is sold at prices normally based upon quotations in these markets. Since suspension of trading on the London Metal Exchange in September 1939, the London market has had no direct influence on New York quotations, and the differential between St. Louis and New York prices has remained at 0.15 cent a pound, an amount approximating the freight charges between the two points.

Announcement by the Office of Price Administration May 29, 1946, of a higher ceiling price for lead, effective June 3, increased the long-established 6.50-cents-a-pound base price of lead, New York, to 8.25 cents. This new price level, although welcomed by the lead-mining industry, was considered by industry spokesmen to be somewhat below that necessary to effect a prompt relief of the prevailing lead shortage. A bill to extend the OPA in modified form was vetoed by the President on June 29, and on July 2 the price of lead advanced to 9.50 cents per pound, New York. With reestablishment of OPA by legislative action on July 25, the former ceiling price of 8.25 cents was restored and prevailed until November 10, the effective date of the Price Administrator's decontrol order, which included the removal of ceiling prices from all metals. The lead market, freed of price limitations and stimulated by brisk consumer bidding for a share of the inadequate supply, responded swiftly to decontrol, and on November 11 lead was quoted at 10.50 cents, New York. Following removal of lead import restrictions by the Civilian Production Administration on November 18, the price advanced to 11.80 cents, New York, which raised the market price to the prevailing import basis, plus freight and duty charges. On December 16 domestic producers advanced the price to 12.55 cents, New York, the highest level on record. The previous record high, which prevailed for a brief period in June 1917, was 12.25 cents, New York.

The general policy of the Quota Committee pertaining to the Premium Price Plan for overquota mine production of domestic lead (copper and zinc were also included) prevailed through June but collapsed with the expiration of OPA and ceiling prices on June 30. Upon reestablishment of the OPA in late July provisions were made for retroactive premium payments to cover the period when no plan was in effect. The Premium Price Plan was extended until June 30, 1947, under the same terms as in the past except that incorporated in the subsidy section of the bill extending the OPA was a provision that "adjustments shall be made to encourage exploration and development work and adequate allowances for depreciation and depletion." The bill further provided that all classes of premiums were noncancelable unless necessary in order to make individual adjustments of income to specific mines. With the abandonment of metal price ceilings on November 9, subsidies to mines financially aided by the Premium Price Plan were computed with average monthly market quotations as a base. A compilation of important data showing production of lead under the Premium Price Plan, 1943–46, at the various quota levels and the payments made is given in the accompanying table.

The official London maximum price of £30 per long ton, duty paid, for Empire and foreign soft lead, fixed by the British Ministry of Supply June 11, 1945, was advanced to £39 January 15, 1946. Subsequent price advances during the year occurred April 8 and July 1, when quotations rose to £45 and £55, respectively. The London price remained unchanged the balance of the year but was raised to £70 per long ton beginning January 1, 1947. Quotations of the London Metal Exchange, discontinued at the outbreak of the war in September 1939, were not resumed during 1946.

Salient statistics on lead with regard to the operation of the Premium Price Plan, 1943–46 [1]

	1943			1944			1945			1946		
	Tri-State district	United States exclusive of Tri-State	United States total	Tri-State district	United States exclusive of Tri-State	United States total	Tri-State district	United States exclusive of Tri-State	United States total	Tri-State district	United States exclusive of Tri-State	United States total
Total production of recoverable lead [2]---short tons	34,830	409,170	444,000	28,956	381,060	410,016	23,097	367,734	390,831	23,887	308,590	332,477
Ceiling production at 6.50 cents a pound---do	1,863	294,001	295,864	3,138	200,619	203,757	1,164	146,791	147,955	2,000	69,327	71,327
Percent of ceiling production to total production---percent	5.35	71.85	66.64	10.84	52.65	49.69	5.04	39.92	37.86	8.37	22.47	21.45
Production under Premium Price Plan:												
"A" quota only (9.25 cents a pound)---short tons	26,259	83,023	109,282	19,494	142,925	162,419	13,009	155,566	168,575	[3] 4,004	[3] 81,330	[3] 85,334
"B" quota (12.00 cents a pound)---do	6,514	32,146	38,660	5,633	37,516	43,149	8,159	65,377	73,536	[3] 14,203	[3] 133,076	[3] 147,279
										[4] 3,680	[4] 24,857	[4] 28,537
Total premium production---do	32,773	115,169	147,942	25,127	180,441	205,568	21,168	220,943	242,111	21,887	239,263	261,150
Metals Reserve mine contracts---do	194		194	691		691	765		765			
Total overceiling production---do	32,967	115,169	148,136	25,818	180,441	206,259	21,933	220,943	242,876	21,887	239,263	261,150
Percentage of overceiling production to total:												
Production under Premium Price Plan:												
"A" quota only---percent	75.39	20.29	24.61	67.32	37.51	39.61	56.32	42.30	43.13	[3] 16.76	[3] 26.36	[3] 25.67
"B" quota (also received "A")---do	18.70	7.86	8.71	19.45	9.84	10.53	35.33	17.78	18.82	[3] 59.46	[3] 43.12	[3] 44.30
										[4] 15.41	[4] 8.05	[4] 8.58
Total premium production---do	94.09	28.15	33.32	86.77	47.35	50.14	91.65	60.08	61.95	91.63	77.53	78.55
Metals Reserve mine contracts---do	.56		.04	2.39		.17	3.31		.19			
Total overceiling production---do	94.65	28.15	33.36	89.16	47.35	50.31	94.96	60.08	62.14	91.63	77.53	78.55
Payments under Premium Price Plan: [5]												
"A" premium---dollars	1,802,497	6,334,273	8,136,770	1,381,983	9,924,261	11,306,244	1,164,240	12,151,860	13,316,100	[3] 726,713	[3] 7,536,723	[3] 8,263,436
"B" premium---do	358,279	1,768,050	2,126,329	309,813	2,063,364	2,373,177	448,722	3,595,711	4,044,433	[3] 1,171,068	[3] 5,984,005	[3] 7,155,073
										[4] 255,818	[4] 1,176,462	[4] 1,432,280
Total premium production---do	2,160,776	8,102,323	10,263,099	1,691,796	11,987,625	13,679,421	1,612,962	15,747,571	17,360,533	2,153,599	14,697,190	16,850,789

Metals Reserve mine contracts [5]	do	16,127		16,127	66,394		66,394	68,934		68,934		
Total overceiling payments	do	2,176,903	8,102,323	10,279,226	1,758,190	11,987,625	13,745,815	1,681,896	15,747,571	17,429,467	2,153,599	14,697,190	16,850,789
Average prices per pound of lead: [6]													
Average premium production	cents	9.797	10.018	9.969	9.866	9.822	9.827	10.310	10.064	10.085	13.320	11.471	11.626
Metals Reserve mine contracts	do	10.651		10.651	11.307		11.307	11.005		11.005			
Total overceiling production	do	9.802	10.018	9.970	9.905	9.822	9.832	10.334	10.064	10.088	13.320	11.471	11.626
Total production	do	9.625	7.490	7.658	9.536	8.073	8.176	10.141	8.641	8.730	12.908	10.781	10.934

[1] From published and unpublished reports of the Office of Price Administration and the Office of Premium Price Plan for Copper, Lead, Zinc and Manganese.
[2] Production of Tri-State lead from Office of Metals Reserve, Joplin, Mo.; all other from Bureau of Mines monthly reports. These data are preliminary and do no exactly equal final annual totals for the United States except for 1945.
[3] January–October. "A" and "B" quotas and premium payments for November and December are not separable by kinds and are shown with data footnoted 4.
[4] Total "A" and "B" quotas and premium payments for November and December; separation by kinds not available.
[5] Data on premium payments and Metals Reserve mine-contract payments from Office of Metals Reserve. All payments shown are subject to correction due to additional payments as a result of retroactive quota adjustments, late reports by smelters and custom mills, etc.
[6] All average prices shown include OPA ceiling price.

Average monthly and yearly quoted prices of lead at St. Louis, New York, and London, 1944–46, in cents per pound [1]

	1944			1945			1946		
	St. Louis	New York	London [2]	St. Louis	New York	London [2]	St. Louis	New York	London [2]
January	6.35	6.50	4.49	6.35	6.50	4.49	6.35	6.50	6.28
February	6.35	6.50	4.49	6.35	6.50	4.49	6.35	6.50	7.01
March	6.35	6.50	4.49	6.35	6.50	4.49	6.35	6.50	7.01
April	6.35	6.50	4.49	6.35	6.50	4.49	6.35	6.50	7.84
May	6.35	6.50	4.49	6.35	6.50	4.49	6.35	6.50	8.09
June	6.35	6.50	4.49	6.35	6.50	5.13	8.03	8.18	8.09
July	6.35	6.50	4.49	6.35	6.50	5.39	9.10	9.25	9.88
August	6.35	6.50	4.49	6.35	6.50	5.39	8.10	8.25	9.88
September	6.35	6.50	4.49	6.35	6.50	5.39	8.10	8.25	9.88
October	6.35	6.50	4.49	6.35	6.50	5.39	8.10	8.25	9.88
November	6.35	6.50	4.49	6.35	6.50	5.39	10.29	10.44	9.88
December	6.35	6.50	4.49	6.35	6.50	5.39	12.02	12.19	9.88
Average	6.35	6.50	4.49	6.35	6.50	4.99	7.96	8.11	8.63

[1] St. Louis: Metal Statistics, 1947, p. 501. New York: Metal Statistics, 1947, p. 495. London: E&MJ Metal and Mineral Markets.

[2] Average price of foreign lead, converted to cents per pound with the pound sterling at $4.02½. Official maximum price raised on June 11, 1945; Jan. 15, 1946; April 8, 1946; and July 1, 1946.

FOREIGN TRADE [2]

Imports.—During 1946 imports of lead dropped to the lowest level since 1939 and were 68 percent below the record total of 1942. As in previous years, the greater part of the lead imported was in the form of pigs and bars, 48 percent of which came from Mexico and virtually all the remainder from Canada, Peru, Japan, and Australia. Receipts of lead in ore and matte, which constituted 28 percent of the total imports, were 37 percent under 1945, due largely to a sharp decline in imports from Australia, Peru, and Canada, which more than offset a moderate increase from Newfoundland. Imports of lead in ore and matte were principally from Newfoundland, Australia, Peru, Canada, and Bolivia, which together supplied 89 percent of these receipts. Imports of lead in base bullion—all from Peru—increased to 125 tons. Five countries supplied 88 percent of the total lead in all forms imported in 1946: Mexico 34 percent, Canada 18, Peru 13, Newfoundland 12, and Australia 11, compared with 54, 10, 16, 5, and 11 percent, respectively, for a total of 96 percent in 1945.

[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Total lead imported into the United States in ore, matte, base bullion, pigs, bars, and reclaimed, 1942–46, by countries, in short tons [1]

Country	1942	1943	1944	1945	1946
Ore and matte:					
Africa	3,879	16,438	3,459	2,338	399
Argentina	4,582			4,716	2,112
Australia	20,997	19,743	27,130	17,913	8,341
Bolivia	1,382	6,934	1,093	1,580	2,202
Canada	7,487	6,828	9,909	8,687	4,940
Chile	3,166		4,247	2,330	1,456
Mexico	2,358	2,931	3,693	667	376
Newfoundland	23,951	13,473	32,273	17,046	19,037
Peru	11,168	3,426	11,295	14,524	5,192
Other countries	392	172	471	204	352
Total	79,362	69,945	93,570	70,005	44,407
Base bullion:					
Australia	42,900	3,846			
Mexico	56	639	11	8	
Peru	16	94	47		125
Other countries	883	4			
Total	43,855	4,583	58	8	125
Pigs and bars:					
Australia	83,352	8,994	560	13,747	8,190
Canada	69,210	16	8	19,389	22,822
Japan					12,126
Mexico	192,044	214,865	167,704	160,179	53,534
Peru	21,891	20,158	54,486	34,153	15,568
Other countries				1	1
Total	366,497	244,033	222,758	227,469	112,241
Reclaimed, scrap, etc.:					
Australia	1,396		2,738	1,470	1,337
Canada	1,292	348	488	1,374	1,078
Panama, Republic of	5	128			12
Peru	57				
Other countries	7	1	89		38
Total	2,757	477	3,315	2,844	2,465
Grand total	492,471	319,038	319,701	300,326	159,238

[1] Data include lead imported for immediate consumption plus material entering the country under bond.

Lead imported for consumption in the United States, 1942–46, by classes [1]

Year	Lead in ores, flue dust, and mattes, n. s. p. f.		Lead in base bullion		Pigs and bars		Sheets, pipe, and shot		Not otherwise specified (value)	Total value [1]
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
1942	87,377	$5,715,251	48,589	$4,285,425	387,693	$32,328,330	20	$7,009	$4,690	$42,478,098
1943	83,153	5,590,218	4,511	557,545	244,033	20,903,382	25	20,208	5,219	27,132,730
1944	100,846	6,756,269	73	7,045	223,379	22,793,430	40	39,572	547	29,895,575
1945	71,046	5,758,695	20	2,242	227,311	25,280,638	14	2,049	32,515	31,311,979
1946	28,377	3,056,111	20	2,302	100,820	14,205,992	24	10,251	21,517	17,491,086

[1] In addition to quantities shown (values included in total values), "reclaimed, scrap, etc." imported as follows—1942: 1,305 tons, $137,393; 1943: 496 tons, $56,158; 1944: 3,315 tons, $298,712; 1945: 2,844 tons, $235,840; 1946: 2,481 tons, $194,913. Figures for 1942–46 include foreign lead received by the Government and held in stock piles.

Miscellaneous products, containing lead, imported for consumption in the United States, 1942–46

Year	Babbitt metal, solder, white metal, and other combinations containing lead			Type metal and antimonial lead		
	Gross weight (short tons)	Lead content (short tons)	Value	Gross weight (short tons)	Lead content (short tons)	Value
1942	971	274	$66,096	245	210	$19,631
1943	236	69	330,824	3,703	3,422	447,019
1944	50	43	15,368	7,562	7,174	954,255
1945	143	73	101,132	26,085	24,706	3,238,902
1946	157	72	211,122	1,740	1,494	220,645

Exports.—Total exports of pig lead in 1946 dropped to 42 percent of the 1945 total. Export restrictions imposed under the Export Control Act of 1940 remained in force throughout the year.

Lead exported from the United States, 1942–46

Year	Pigs and bars		Foreign lead exported in manufactures with benefit of draw-back (short tons)	Year	Pigs and bars		Foreign lead exported in manufactures with benefit of draw-back (short tons)
	Short tons	Value			Short tons	Value	
1942	1,940	$285,354	26,258	1945	1,407	$202,754	(1)
1943	2,003	244,433	15,491	1946	597	106,457	(1)
1944	15,523	2,073,145	20,237				

[1] Data not available.

Pig lead exported from the United States, 1942–46, by destinations, in short tons

Destination	1942	1943	1944	1945	1946
Countries:					
Brazil	51	779	450	406	281
Canada	2	9	5	8	40
Chile	18	7	23	215	2
China			1		8
Colombia	5	51	34	25	49
Cuba	4	26	18	156	58
Curaçao (N. W. I.)	15	9	9	14	11
Czechoslovakia					10
Mexico	7	5	8	32	17
Panama, Republic of	15	8	18	23	17
Philippines, Republic of					16
Portugal			542	257	
Sweden	224				
U. S. S. R.	6	14	14,314	66	
United Kingdom	1,379	1,017			
Uruguay			7	2	10
Venezuela	20	8	17	75	34
Other countries	194	70	77	128	44
Total [1]	1,940	2,003	15,523	1,407	597
Continents:					
North America	135	80	80	273	170
South America	190	883	541	761	381
Europe	1,609	1,031	14,867	323	11
Asia	4	6	30	44	35
Africa and Oceania	2	3	5	6	(2)

[1] In addition 3,874 tons of foreign lead were reexported in 1942, 11,258 tons in 1943, less than 1 ton in 1944, 377 tons in 1945, and 103 tons in 1946.
[2] Less than 1 ton.

WORLD REVIEW

Foreign production of lead was a subject of particular significance during 1946 in the light of the world-wide shortage in lead supplies. Data on lead output for 1946 outside the United States are fragmentary. It is believed, however, that production handicaps imposed by labor strikes, manpower shortages, and lack of fuel limited world output for 1946 to approximately 1,166,000 metric tons.

World production of lead, 1939–46, in metric tons [1]

[Compiled by B. B. Mitchell]

Country	1939	1940	1941	1942	1943	1944	1945	1946
Argentina	13,978	12,864	18,021	20,760	23,800	19,100	21,159	16,190
Australia	238,298	256,129	239,052	255,409	192,322	157,026	158,353	153,556
Austria	10,187	8,202	8,879	8,787	12,043	10,123	1,272	4,476
Belgium	96,190	30,800	8,880	16,240	7,960	7,690	7,340	23,762
Burma	78,622	80,709	74,456	17,130				
Canada	172,880	199,662	206,862	220,722	203,091	129,347	147,999	150,360
China	467	1,210	1,405	1,169	1,179	153	850	14
Czechoslovakia	[2] 5,000	([3])	([3])	([3])	([3])	([3])	([3])	([3])
France	42,381	25,577	23,220	12,462	12,428	4,572	6,984	34,680
Germany [4]	175,500	167,100	163,900	140,100	157,200	[2] 139,900	([3])	([3])
Greece	4,925	1,250	890	2,300	1,150	600	700	609
Guatemala	16	([3])	95	119	114	136	115	131
Hungary [5]	90	110	4,640	4,810	6,370	[6] 3,230	([3])	([3])
Indochina, French	5	8	3	2	16	([3])	([3])	([3])
Italy	38,818	36,909	36,993	28,771	[6] 12,372		829	14,016
Japan [7]	18,261	27,748	30,585	26,919	32,511	38,048	12,568	([3])
Korea (Chosen)	7,957	7,630	10,000	11,900	18,467	21,200	[8] 2,096	([3])
Mexico	213,675	191,980	151,167	192,989	212,452	178,270	201,078	137,742
Northern Rhodesia	163	293	378	1,118	1,265	1,047	1,748	8,371
Norway	321	123	39				52	([3])
Peru	24,310	31,131	32,871	37,915	43,171	38,906	40,001	36,478
Poland	[2] 25,000	[2] 23,000	[2] 25,000	([3])	([3])	([3])	[2] 7,000	8,952
Rumania	5,664	49	258	154	187	261	([3])	1,270
South West Africa	4,283	690		([3])	([3])	([3])	([3])	([3])
Spain	25,991	45,991	46,865	41,149	36,760	30,978	31,922	32,346
Sweden				230	2,193	10,553	13,801	8,618
Tunisia	22,930	26,620	15,679	8,210	1,867	5,335	7,023	7,482
Union of South Africa	11	([3])	([3])	([3])	([3])	([3])	([3])	([3])
U. S. S. R.	74,800	[2] 75,000	[2] 90,000	[2] 100,000	[2] 125,700	[2] 110,000	([3])	([3])
United Kingdom	16,886	13,813	8,097	5,483	4,234	4,033	2,911	2,738
United States (refined) [9]	404,257	468,675	494,126	497,908	425,903	421,538	402,304	306,717
Yugoslavia	10,652	32,949	([3])	([3])	([3])	([3])	([3])	([3])
Total [10]	1,733,000	1,766,000	1,722,000	1,708,000	1,575,000	1,363,000	1,250,000	1,166,000

[1] By countries where smelted but not necessarily refined. Data derived in part from Statistical Year Book of the League of Nations and from the American Bureau of Metal Statistics (annual issue).
[2] Approximate production.
[3] Data not yet available; estimate by author of chapter included in total.
[4] Exclusive of secondary material. Beginning in October 1939 includes Upper Silesia. Data from Metallgesellschaft, Frankfort on Main.
[5] Includes Northern Territories and Sub-Carpathia; in addition beginning in 1941, includes Eastern Hungary and Transylvania; and beginning in 1942 includes Southern Territories.
[6] January to June, inclusive.
[7] Preliminary data.
[8] South Korea only.
[9] Figures cover lead refined from domestic and foreign ores; refined lead produced from foreign base bullion not included.
[10] Estimated by author of chapter.

Argentina.—Lead production in Argentina, though not large, has considerable importance, as it supplies domestic needs and affords a substantial surplus of lead concentrates for export. Because of the smelting facilities in Argentina, several thousand tons of high-grade lead ores are imported each year from Bolivia. At the National Lead Co. smelter at Puerto Vilelas, Bolivian ore is mixed with the lead concentrates from the Aguilar district, Province of Jujuy. The Compania Minera Aguilar, S. A., subsidiary of the St. Joseph Lead Co.,

supplied virtually all the Argentine mine output of lead in 1946 from its property at Tres Cruces in the Aguilar district. The mine operated at approximately 60 percent capacity during most of the year owing to a persistent shortage of railroad rolling stock, which prevented adequate shipments of fuel oil, mine timber, and miscellaneous supplies to the mine and the movement of concentrates therefrom. The production of lead concentrates at the Aguilar mine in 1946 was 22,031 metric tons compared with 22,022 tons in 1945.

Australia.—During 1946 the Zinc Corp., Ltd., treated 448,037 tons of ore, from which 79,313 tons of lead concentrates were recovered, compared with 425,542 tons and 81,490 tons, respectively, in 1945. At the New Broken Hill Consolidated property, adjoining the Zinc Corp. on the south and managed by that company, ore output was increased from 3,468 tons in 1945 to 41,723 tons in 1946. Lead concentrate production increased tenfold to 3,851 tons.

The Lake George Mining Corp., Ltd., at Captain's Flat, New South Wales, produced 135,244 tons of ore in 1946, from which 12,599 tons of lead concentrates were recovered. Ore reserves at the year's end were estimated at 1,382,753 tons assaying 1.1 dwt. gold and 1.44 ounces of silver per ton, 7.24 percent lead, 12.35 percent zinc, and 0.68 percent copper.

A shortage of skilled labor and lagging development work were named by the Electrolytic Zinc Co. of Australasia as the principal factors limiting mine output in the year ended June 30, 1946. Mine production totaled 118,343 tons assaying 1.96 dwt. gold and 6.89 ounces of silver per ton, 18.92 percent zinc, 5.64 percent lead, and 0.53 percent copper, from which about 7,400 tons of lead concentrates containing 59 percent lead were recovered.

Austria.—Lead-zinc ore averaging 11 percent lead and 5 percent zinc was produced at the Bleiberg mine, 30 miles west of Klagenfurt in Carinthia. No ore was produced in 1945 following the German surrender in May, but 34,000 metric tons were mined in 1946. The production of lead and zinc concentrates was estimated at 1,400 and 1,500 tons, respectively. Refined lead is produced at Bleiberg in quantities sufficient to meet normal domestic requirements.

Bolivia.—Exports of lead concentrates totaled 9,297 short tons in 1946, a decline of 11 percent from the quantity shipped in 1945.

Burma.—No production was recorded from the Bawdwin mine of the Burma Corp., Ltd., in 1946. The company proceeded with salvage operations and rehabilitation of installations destroyed during the Japanese occupation. The mill at Namtu was completely wrecked by the Japanese; but the smelter, also at Namtu, was only slightly damaged. The hydroelectric plant at Mansam Falls, about 25 miles from Namtu, one of four originally operated by the company, was restored to provide power for unwatering operations at the mine. Officials of the Burma Corp., Ltd., indicated late in 1946 that the possibility of full-scale production at the Bawdwin mine before mid-1949 appeared unlikely. Factors delaying the resumption of mining and smelting operations were the uncertain political situation in Burma; the limited ore reserves remaining at the property; current high cost of operations; and the major construction necessary to restore railway communications with Rangoon.

Canada.—Although lead production increased slightly in Canada in 1946, the level of output remained considerably below the wartime peak in 1942. At Trail, British Columbia, the Sullivan mine of the Consolidated Mining & Smelting Co., which operates the only Canadian lead smelter and electrolytic lead refinery, continued to be the principal source of Canadian lead production. Refined lead produced at the Trail smelter increased to 165,744 tons from 163,142 tons in 1945. Ore reserves at the end of the year showed a net increase of about 3 million tons, 25 percent of which was new ore and the remainder from recalculations of existing reserves made possible by a series of new geological studies. The company reports that ore reserves in 1946 were greater than in April 1940, when positive and probable ore reserves were estimated to be sufficient for more than 20 years' operation at the then existing rate of extraction. During 1946 construction was begun on a new underground crushing plant located near the center of the mine, a 4-mile haulageway to the concentrator (which will be used to return waste rock for back-fill), and an addition to the mill for preliminary treatment of the ore by the sink-float method. Completion of these projects, which are estimated to cost about $3,000,000, is anticipated by the summer of 1948.

Other producing mines in British Columbia, all of which were closed during a portion of the year by labor strikes, included the Base Metals Mining Corp., Ltd., which shipped lead and zinc concentrates from the Monarch and Kicking Horse mines at Field; the Santiago Mines, Ltd.; and the Zincton Mines, Ltd.

The New Calumet Mines, Ltd., at Calumet Island, Quebec, during 1946, milled 208,860 tons of ore, from which 3,725 tons of lead were recovered. All the lead concentrates produced during the year were sold to Belgian smelters. Ore reserves on September 30, 1946, were estimated at 944,964 tons, assaying 5.46 ounces of silver, 0.022 ounce of gold per ton, 2.7 percent lead, and 9.2 percent zinc.

France.—Although French lead output in 1946 was about 82 percent of that in prewar 1938, production was far short of the domestic requirements. The lack of coal and—to a lesser extent—shortage of manpower continued to limit output.

Hungary.—Lead production in Hungary dropped to the pre-1941 level as a result of a treaty signed in 1946 that restored Transylvania to Rumania. The increased output of lead in 1941–43 was accounted for by the annexation of Transylvania August 30, 1940.

Italy.—Zinc-lead mines in Italy in 1946, produced 206,115 metric tons of ore, from which 22,315 tons of lead concentrates, containing an average of 62 percent lead, were made. Production was curtailed, however, owing to inability of smelters to obtain sufficient coke to treat all ore produced.

Japan.—Since 1925 the Japanese lead industry has produced only 12 percent of the domestic lead requirements, and consumers were forced to rely heavily on imports of lead concentrates and refined lead. From the latter part of 1931 until the middle of 1945 the Japanese Government concentrated every effort on becoming self-sufficient in mineral supplies. Despite the urgency for expanded mine production following 1941, when virtually all sources of imports were cut off, Japanese lead mines were unable to produce more than 20 percent of the domestic

requirements. Partly refined lead from Korea and Manchuria filled another 20 percent of the needs, and the remainder was met by heavy withdrawals from stocks accumulated since 1934. Proved and probable ore reserves at the seven major zinc-lead producing mines, plus those of five other mines whose reserves are relatively large, total 18,660,000 metric tons averaging 1.4 percent lead and 6.5 percent zinc.

Salient statistics of the lead industry in Japan, 1940–45, in metric tons [1]

	1940	1941	1942	1943	1944	1945
Mine production of recoverable lead	16,649	16,409	18,334	20,058	16,100	4,660
Smelter production of refined lead	27,748	30,585	26,919	32,511	38,048	12,568
Imports:						
Crude lead and concentrates	10,593	14,182	7,031	10,831	21,092	4,426
Refined lead	92,091	78,532	950	4,393	2,586	182
Exports of refined lead	1,294					
Apparent domestic consumption	118,545	109,117	27,869	36,904	40,634	12,750

[1] Natural Resources Section Report 65, Zinc-Lead Resources of Japan. General Headquarters, Supreme Commander for the Allied Powers, Tokyo, 1947.

Mexico.—Labor strikes, poor railroad facilities, and high taxes were the principal factors limiting Mexican lead output in 1946. On December 31, 1945, a general strike of Mexican mine and smelter labor, originally scheduled for December 17, shut off lead output until the end of February 1946, when new wage scales were established and the workers returned to their jobs.

During the year an increasing proportion of Mexican lead production was shipped to destinations other than the United States. Because of the disruption of European markets during the war, large tonnages of Mexican production were exported to the United States. With the end of hostilities, however, European buyers were again bidding for Mexican lead at prices which, during most of 1946, were considerably higher than the ceiling price in the United States. Data on Mexican foreign lead trade for the first half of 1946 indicate that over 90 percent of the domestic production was exported, approximately 17 percent going to Europe, 5 percent to Brazil, and 78 percent to the United States.

Production at the Minas de Guerrero lead-zinc property in the Taxco Mining district owned and operated by Minas de Guerrero, S. A., a subsidiary of the Eagle-Picher Co., was virtually halted at the end of the year owing to depletion of ore reserves and shortage of labor. The company plans to dismantle the 800-ton selective flotation mill—erected in 1943—and move it together with all mining equipment to the Esmeralda mine in the Parral district, State of Chihuahua.

Exploration by the American Smelting & Refining Co. at the San Antonio mine in the Taxco district during mid-1946 reportedly disclosed a substantial tonnage of silver-lead-zinc ore. If certain contiguous claims can be acquired, the company will dismantle its flotation mill at Pedregal and rebuild it into a larger plant at San Antonio.

Newfoundland.—In Newfoundland about 384,000 short tons of ore were mined and milled during 1946, providing 39,727 tons of lead concentrates containing approximately 22,670 tons of lead.

Peru.—A continued shortage of labor and a cave-in at the Huaron mine were largely responsible for the decline in Peruvian lead production from 53,664 metric tons in 1945 to about 45,000 tons in 1946.

The 800-ton-per-day flotation plant of the Cerro de Pasco Copper Corp. treated copper ores exclusively until mid-1946, after which approximately equal tonnages of copper and zinc-lead ores were milled. Part of the lead concentrates produced was exported, and part was smelted at Oroyo.

The Compania Minero de Sayapullo, financed wholly by Peruvian capital, reopened the old mines at Sayapullo in the Department of Cajamarca. Exploration disclosed a substantial tonnage of lead-zinc-silver-cadmium ore sufficiently large to warrant construction of a 100-ton-a-day flotation mill, which was put into operation at the end of 1946.

The Banco Minero de Peru constructed a 100-ton-a-day flotation plant at Huachacolpa in the Department of Huancavelica designed to treat on a custom basis lead-zinc ores from a number of small mines in the district.

Exploration by the Picasso Bros. at the old Candalosa silver-lead property in the Castrovirreyna district of the Department of Huancavelica developed enough ore (including old dumps) to warrant construction of a 150-ton-a-day flotation mill.

Spain.—The mine production of lead concentrates in Spain from 1939 through 1946, in metric tons was as follows:

	1939	1940	1941	1942	1943	1944	1945	1946
Lead concentrates	31,700	57,800	46,300	45,000	46,200	48,400	37,050	53,600
Lead content	23,300	42,400	33,700	32,200	33,000	34,800	26,200	38,900

United Kingdom.—Consumption of pig lead (virgin metal) in the United Kingdom totaled 193,506 long tons in 1946 compared with 223,591 tons in 1945. Over-all consumption, including pig lead recovered from scrap, was 317,195 tons (294,104 tons in 1945), of which 27 percent was used in cable covering; 26 percent in sheet and pipe; 16 percent in batteries; 16 percent in white lead and oxides, excluding battery oxide; and 15 percent for miscellaneous purposes.

Stocks of refined lead in the United Kingdom on December 31, 1946, totaled 24,300 long tons. Government-owned stocks abroad (excluding quantities at port or in transit) were 20,100 tons.

U. S. S. R.—Virtually no official production figures have been available on the Russian lead industry during the past 7 years. Certain data, however, presented in the announcement March 1946 of the new 5-year plan indicated that lead output has been declining in recent years. Most of the lead smelted in the Soviet Union is produced in Kazakhstan.

Lead and Zinc Pigments and Zinc Salts

By HELENA M. MEYER AND ALETHEA W. MITCHELL

GENERAL SUMMARY

THE lead and zinc pigments industry had to contend in 1946 with a continuation of the unbalanced supply-demand relationship that prevailed in 1945 and several earlier years, despite the fact that 1946 was a full peacetime year. Demand for pigments as a whole was at near record levels; but shortages of essential crude materials, again notably lead and linseed oil, made it impossible for producers to fill a large segment of requirements. Labor strikes prevented the disparity from being even greater than it was. Strikes in chief pigment-consuming industries, such as the automobile industry, reduced potential demand by such industries, and steel and coal strikes interfered with construction and other activity that would have increased pigments requirements materially. Presumably the prospective demand cut off by strikes in 1946 was merely deferred, so that total pigment needs appear headed for new records in the near future. Various pigments probably will share unequally in supplying the demand, however. White lead production gains, for example, depend chiefly on improvement in over-all supplies of pig lead, whereas the present capacity output of titanium pigments will rise with the completion of plant expansion now in progress.

The stringent pigment-supply situation, accompanied by the removal of price controls in November, led to the highest prices in many years for pigments covered by this report—for lead pigments the highest prices ever recorded.

Shipments of the pigments and chemicals covered by this report were generally at higher levels in 1946 than in 1945. Noteworthy exceptions were litharge and red lead, which had fared better than other lead pigments in restriction orders of the recent past. As pointed out in the report of this series for 1945, white lead carbonate and sulfate bore the brunt of lead curtailment in that year. The fact that white lead (basic carbonate and basic sulfate) had larger percentage gains in 1946 than other pigments covered by this report, therefore, is not particularly significant, except as a reflection of partial relief from restriction. In 1945 shipments of white lead in oil, for example, were the smallest since considerably before the beginning of the present century, and shipments of basic sulfate were smaller than at any time since before the first figures were published in 1902.

Despite Government controls on the consumption of lead, stimulus to production through Government assistance in expediting equipment and supplies to producers, continued release to consumers of metal from Government inventories, and the continued payment of premiums for overquota production, as well as some liberalization of the plan, the lead shortage became more severe as the year progressed. This was due chiefly to mine and smelter strikes in the first half of the year, to labor shortages throughout the year, and to inadequate development work for several years. Receipts of crude and refined lead from abroad also dropped sharply in 1946. Supplies of zinc, on the other hand, were abundant as compared with those of lead; domestic production was less affected by strikes, and imports of crude and refined zinc compared much more favorably with those for 1945. Producers of pigments, however, were not always able to obtain metal when needed.

Shipments of the competitive titanium-pigments group established a new high record again in 1946 but were inadequate to supply demand. Plant capacity, in process of expansion, is the limiting factor in connection with this product.

Salient statistics of the lead and zinc pigments industry of the United States, 1941–46

	1941	1942	1943	1944	1945	1946
Production (sales) [1] of principal pigments:						
White lead (dry and in oil)—short tons	113,000	83,639	76,167	85,726	51,170	[2] 66,501
Litharge—do	122,280	91,513	113,091	138,203	138,798	133,799
Red lead—do	53,838	48,369	53,378	53,972	47,381	32,526
Zinc oxide—do	148,833	99,677	143,402	140,675	127,955	157,851
Leaded zinc oxide—do	68,920	48,128	43,828	64,395	62,598	67,971
Lithopone—do	176,642	137,320	135,723	142,905	136,161	147,001
Value of products:						
All lead pigments	$46,572,000	$39,393,000	$41,897,000	$46,601,000	$39,045,000	$43,595,000
All zinc pigments	39,210,000	30,785,000	36,260,000	39,288,000	36,644,000	44,195,000
Total	85,782,000	70,178,000	78,157,000	85,889,000	75,689,000	87,790,000
Value per ton received by producers:						
White lead (dry)	$147	$160	$163	$163	$159	[2] $207
Litharge	134	150	152	146	148	175
Red lead	161	171	171	164	168	196
Zinc oxide	125	138	137	139	138	144
Leaded zinc oxide	118	129	132	132	132	143
Lithopone	71	79	79	78	78	81
Foreign trade:						
Lead pigments:						
Value of exports	$1,228,000	$957,000	$1,439,000	$1,387,000	$1,421,000	$851,000
Value of imports	12,000	4,000	3,000	6,000	8,000	13,000
Zinc pigments:						
Value of exports	3,525,000	2,741,000	2,737,000	2,017,000	2,279,000	2,911,000
Value of imports	22,000	8,000	5,000	1,500	[3]	9,000
Export balance	4,719,000	3,686,000	4,168,000	3,396,500	3,692,000	3,740,000

[1] Reported as shipments in 1945 and 1946.
[2] Data for basic lead sulfate in 1946 included under white lead; Bureau of Mines not at liberty to show separately.
[3] Less than $500.

Chief among the outlets for pigments are the paint, automobile, storage battery, and rubber industries. Sales of paint, varnish, and lacquer materials (figures for which are compiled by the U. S. Depart-

ment of Commerce) established a new high record in 1946 for the fourth successive year, being valued slightly below $800,000,000. The withdrawal of price controls in November and the consequent price advances in pigments and linseed oil to considerably higher levels by the end of December contributed to the record value of paint sales in 1946, although the total would have been much greater except for shortages, already mentioned, of essential raw materials. Automobile sales (passenger vehicles and trucks) in 1946 were 326 percent above the subnormal total for 1945 but 36 percent below 1941. Labor strikes in the steel industry and in the automobile industry itself were principal impediments to larger production in 1946. In January 1947 a General Motors executive stated [1] that output of cars and trucks may not reach 5,000,000 in 1947 (3,000,000 in 1946).

The distribution of lead and zinc pigments and zinc salts in 1946 presented a number of notable features. Ceramics, which take a relatively small share of the total pigments consumed, increased most in 1946, after making one of the poorest showings during war years. Litharge is shipped to ceramics makers in larger quantities than other pigments covered by this report; in 1946 shipments rose 14 percent and were the largest since 1941. The use of red lead in ceramics virtually doubled in 1946 and also was the highest since 1941. Zinc oxide shipments to ceramics makers established a new high record in 1946, advancing 78 percent above 1945. Zinc oxide's excellent performance in 1946, when total shipments had been exceeded only twice before (1928 and 1929), was due chiefly to the sharp advance in the quantities taken by the rubber industry. The availability and use of larger quantities of natural rubber were important factors in this movement. Zinc oxide, leaded zinc oxide, and lithopone sales to paint makers were notably above other recent years; leaded zinc oxide sales for paints were the second highest on record, of zinc oxide the greatest since 1930, and of lithopone the largest since 1941. The use of these pigments in paints has been stimulated by lead-pigment shortages, as previously indicated. Sales of white lead, carbonate, and sulfate for paints, whereas larger than in 1945, were not at a high rate in relation to earlier years. Storage-battery manufacture probably maintained the highest pigment-consumption rate of all uses during the war, but shipments of lead oxides, litharge, and red lead for this purpose declined in 1946. More zinc sulfate was used for agricultural purposes and by manufacturers of rayon in 1946 than ever before, accounting for the record shipments of that compound.

Government Controls.—In mid-December 1945 lead chemicals were incorporated under War Production Board lead order M–38. A new Civilian Production Administration lead chemicals order, L–354, established in April 1946, restricted consumers of lead for the pigments covered by this report (except that part of litharge and red lead used for battery manufacture, lead arsenate, and lead arsenite) to 38½ percent of the aggregate quantity each had put into process during the first 6 months of 1944, or 5,000 pounds, whichever was greater. Insecticides were restricted to 45 percent of the base period. Inventories were subject to the provisions of Priorities Regulation 32. The continuing acute lead-supply situation led to the establishment of com-

[1] Quoted in American Metal Market, vol. 54, No. 11, January 16, 1947, p. 1.

plete allocation control, under lead order M–38 at the beginning of July, over battery oxides (including litharge, black oxide, red lead, and basic lead sulfate) for use in the manufacture of storage batteries. A revision in the chemicals order, July 11, 1946, increased lead allotments for the production of lead chrome pigments, taking cognizance of the fact that production in the base period had been restricted by provisions for chrome rather than lead. A further curtailment to 35 percent was made in the October 8 revision of L–354 and cut the quantity to be used for insecticides for the period October 18 to December 31, except by special permission of the Civilian Production Administration. Under pressure on all sides to remove all controls, the Government removed those on the use of lead effective December 27, 1946. Inventory restrictions, however, were retained.

Zinc-consumption controls had been removed in 1945.

Office of Price Administration ceiling prices on pigments and pastes with a high lead content were increased effective June 7, 1946, following a rise in the ceiling price for lead—the first advance permitted since establishment of the General Maximum Price Regulation in 1942. During the almost month-long interim in the operation of OPA in July, producers raised prices for zinc oxide (lead-free and leaded) temporarily. Ceiling price advances on zinc oxide of 0.75 to 1 cent a pound were granted by OPA on October 14, 1946, the first official increase since 1942. All price controls on the products covered by this report were removed by order of the Price Administrator, effective November 10, and prices were at their highest at the year end.

Outlook.—Havey [2] discussed the outlook for zinc pigments, but his findings apply in large part also the lead group. He said,

* * * However, regardless of what the future may hold for business in all lines of consumer products, the soundness of the zinc pigment position lies in the essential character of the industries in which zinc pigments play a necessary part—rubber, paint, linoleum, glass, ceramics, pottery, oilcloth, etc., * * *.

Commenting on potentialities for the paint industry, a principal consumer of the products covered by this report, he said,

* * * The paint industry has potential capacity to produce considerably more paint than was made during the war years. The only thing which may handicap them in reaching their announced goal of $1,000,000,000 annual sales is the lack of raw materials, the principal ones being zinc oxide (lead-free and leaded), white lead (both carbonate and sulfate), zinc sulfide pigments (including lithopone), titanium dioxide and linseed oil. The available supply of these is far below present demand * * *.

European Drying-Oil Problems.—European manufacturers of paint, varnish, and lacquer, like those in the United States, only to a greater degree, suffered seriously from shortages of oils and natural resins. Eleven novel developments in the German paint, varnish, and lacquer industry were described [3] recently. The report outlined the organization and operation of the German paint industry, listed the raw materials available to the Germans and contained descriptions and formulas for general types of coatings. The conclusion was reached that American products in general, were superior to German products in working qualities, appearance, and durability; but that the Germans,

[2] Havey, M. L., Market Outlook for Zinc Pigments: Address presented at 29th annual meeting, Zinc Inst., Inc., Apr. 28, 1947, reprinted in the Am. Met. Market, vol. 54, No. 84, May 1, 1947, p. 9.
[3] Office of Military Government for Germany (US), Paint, Lacquer, and Varnish Industry of Germany: Fiat Final Report 681, 1946, 66 pp.

nevertheless, produced satisfactory paints, varnishes, and lacquers, despite wartime shortages in oils, natural resins, and certain pigments. In doing so they deviated considerably from American practices.

Great attention was given to the question of making paints and enamels without, or with minimum quantities of drying oils by a paint-making concern with factories in Belgium and France.[4] Residual gums obtained from the distillation of crude benzol and of light tar oils were tried. Three types of tar-oil distillation residues are resinol, resigum, and resilin. The article claimed that paints can be made with resigum without the addition of any natural drying oil but stated that such paints do not give as good a finish as normal paints.

The serious effect of shortages of crude materials, linseed oil in particular, on British exports of paints was pointed out in a recent report.[5] The report stated that the prewar value of Britain's export trade in paints, varnishes, and related products was about £4,000,000 a year. "Present" raw material restrictions were likely to cause a drop to £500,000 or less for 1946.

Devices practiced by the French paint industry during enemy occupation were outlined [6] in 1946.

PRODUCTION

Figures on sales have been used in this series of reports for many years as a better guide to activity in the pigments industry than production. Data on lead and zinc pigments produced from ores now are compiled by the Bureau of Mines on questionnaires for lead and zinc. Because lead and zinc schedules ask for shipments rather than sales, for uniformity the pigments schedule was changed to cover shipments. Available data made it appear that sales and shipments in 1945, the year of change, were little different. In reporting tonnages of pigments an attempt is made to avoid all duplication. One of the chief problems is that finished pigments frequently are blended to make another product. Basic lead sulfate and zinc oxide, for example, are blended to make leaded zinc oxide, and in this instance the pigment weights appear in the total for the last-named class only. Pigments consumed by producing companies to make products beyond those covered by this report—that is, paints, storage batteries, and other articles—are considered as shipments.

The value of lead and zinc pigments in 1946 totaled $87,790,000, a 16-percent increase over 1945. Lead and zinc pigments each represented 50 percent of the total compared with 55 and 45 percent, respectively, in 1939.

LEAD PIGMENTS

Total lead-pigments shipments declined 4 percent in quantity in 1946 despite the fact that white lead (carbonate and sulfate) showed substantial gains over the low tonnages shipped for 1945. Contrary to their war records, red lead and litharge dropped in 1946, the drops more than offsetting white-lead increases. All pigments were affected adversely by the inability of pigment manufacturers to obtain ade-

[4] Digested in Chem. and Met. Eng., vol. 53, No. 6, June 1946, p. 208.
[5] Chemical Age, British Paints for Abroad: Vol. 55, No. 1429, November 16, 1946, p. 604.
[6] Oil, Paint and Drug Reporter, Paint Technology in France During the Enemy Occupation: Vol. 150, No. 20, November 11, 1946, pp. 87–89.

quate supplies of pig lead, and the demand for lead pigments was far from satisfied. The value of lead pigments rose 12 percent in 1946 owing to first the easing and then the removal of price controls (discussed under Government Controls); the 1946 value was 23 percent above that for 1939. Average values of all lead pigments increased substantially in 1946, and by the end of the year quoted prices were at high rates never before attained.

Lead pigments shipped by domestic manufacturers in the United States, 1945–46

Pigment	1945			1946		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Basic lead sulfate or sublimed lead:						
White	2,235	$318,900	$143	(1)	(1)	(1)
Blue	1,660	237,890	143	(1)	(1)	(1)
Red lead	47,381	7,963,888	168	32,526	[2] $6,398,035	[2] $196
Orange mineral	230	59,906	260	123	(2)	(2)
Litharge	138,798	20,566,670	148	133,799	23,440,389	175
White lead:						
Dry	27,382	4,346,124	159	[1] 41,892	[1] 7,491,217	[1] 179
In oil [3]	23,788	5,552,118	233	24,609	6,265,030	255

[1] Basic lead sulfate included under white lead (dry) in 1946; Bureau of Mines not at liberty to publish.
[2] Value of orange mineral included under red lead in 1946; Bureau of Mines not at liberty to publish.
[3] Weight of white lead only but value of paste.

Lead pigments sold [1] by domestic manufacturers in the United States, 1942–46, in short tons

Year	White lead		Basic lead sulfate or sublimed lead		Red lead	Orange mineral	Litharge
	Dry	In oil	White	Blue			
1942	35,865	47,774	7,229	1,181	48,369	128	91,513
1943	39,525	36,642	4,752	845	53,378	79	113,091
1944	46,466	39,260	5,253	1,080	53,972	284	138,203
1945	27,382	23,788	2,235	1,660	47,381	230	138,798
1946	[2] 41,892	24,609	(2)	(2)	32,526	123	133,799

[1] Reported as shipped in 1945 and 1946.
[2] Basic lead sulfate included under white lead (dry) in 1946; Bureau of Mines not at liberty to publish.

ZINC PIGMENTS AND SALTS

The more favorable supply-demand relationship in zinc as compared with lead, pointed out in the chapter of this series for 1945, continued and was accentuated in 1946. As a consequence, shipments of leaded zinc oxide were second only to those for 1941, being only 1 percent less, and shipments of lead-free zinc oxide were second only to those in 1928 and 1929. Lithopone shipments were far below a record in 1946 but were at a relatively high rate, nonetheless. In total value, zinc pigments were 21 percent above 1945 and 53 percent above 1939. Average values for all products covered by this report were higher owing to the October increase in the OPA ceiling prices and to the removal of ceilings by the general Presidential order effective November 10.

Shipments of zinc chloride totaled 57,316 tons (50° B.), continuing at the high levels of the preceding 2 years. Zinc sulfate sales established a new high record for the second successive year.

Zinc pigments and salts shipped by domestic manufacturers in the United States, 1945–46

Pigment or salt	1945			1946		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Zinc oxide [1]	127,955	$17,708,795	$138	157,851	$22,660,450	$144
Leaded zinc oxide [1]	62,598	8,290,073	132	67,971	9,694,067	143
Lithopone	136,161	10,645,316	78	147,001	11,840,596	81
Zinc chloride, 50° B	56,230	2,828,474	50	57,316	3,133,891	55
Zinc sulfate	20,854	1,712,058	82	24,931	2,192,706	88

[1] Zinc oxide containing 5 percent or more lead is classed as leaded zinc oxide. In this table data for leaded zinc oxide include a small quantity containing less than 5 percent lead.

Zinc pigments and salts sold [1] by domestic manufacturers in the United States, 1942–46, in short tons

Year	Zinc oxide	Leaded zinc oxide [2]	Lithopone	Zinc chloride (50° B.)	Zinc sulfate
1942	99,677	48,128	137,320	52,374	14,331
1943	143,402	43,828	135,723	53,707	15,649
1944	140,675	64,395	142,905	57,545	17,156
1945	127,955	62,598	136,161	56,230	20,854
1946	157,851	67,971	147,001	57,316	24,931

[1] Reported as shipped in 1945 and 1946.
[2] Includes a small quantity containing less than 5 percent lead, 1943–46.

CONSUMPTION BY INDUSTRIES

WHITE LEAD

As was to have been expected, shipments of white lead (dry and in oil) rebounded in 1946 from the low levels for 1945. Owing to the stringent provisions of War Production Board chemicals order M–384, through which white lead (carbonate and sulfate) was called upon to bear the brunt of curtailment in the use of lead in 1945 (discussed in the report of this series for 1945), shipments of white lead (dry) in 1945 were the smallest since 1934 and of white lead in oil the smallest since considerably before the beginning of the present century. In 1946, for the first time, the Bureau of Mines is not at liberty to show data on basic lead sulfate separately and must combine them with figures on white lead in order that lead pigments totals may be published. White lead and basic lead sulfate shipments gained more in 1946 than the other products covered by this report. The increased tonnages could not fill the large demand for white lead pigments, however, and inadequate pig-lead supplies interfered with greater production. Both white lead carbonate and sulfate are used chiefly in paints, and 92 percent of the combined tonnage was so used in 1946.

A better break-down of the "Other" class probably would increase the quantity shown under the "Paint" class. Use of white lead carbonate in ceramics in 1946 followed the uptrend in use of other pigments for this purpose.

The facilities of the International Smelting & Refining Co. at East Chicago, Ind., for the production of white lead and zinc oxide were purchased by the Eagle-Picher Co. in 1946.

Production of white lead (dry, including basic lead sulfate, amounted to 42,597 tons and of white lead in oil to 24,501 tons in 1946. In 1945, 26,329 tons of white lead (dry) and 23,194 tons in white lead in oil were produced.

Distribution of white lead (dry and in oil) sales [1] 1942–46, by industries, in short tons

Industry	1942	1943	1944	1945	1946 [2]
Paint	76,837	66,441	79,948	46,418	60,943
Ceramics	1,812	1,444	946	839	1,367
Other	4,990	8,282	4,832	3,913	4,191
	83,639	76,167	85,726	51,170	66,501

[1] Reported as shipments in 1945 and 1946.
[2] Data for basic lead sulfate in 1946 included under white lead; Bureau of Mines not at liberty to show separately.

BASIC LEAD SULFATE

Basic lead sulfate, along with lead carbonate, was affected seriously by the provisions of Order M–384, as pointed out in the report of this series for 1945. Figures for 1946 cannot be published separately and are included under White Lead (dry). The rise in shipments in 1946 was merely a gain over the smallest tonnage recorded since the first figures were published in 1902. This pigment is used chiefly in paints. The figures for shipments in the accompanying table exclude substantial tonnages used as an intermediate product in the manufacture of leaded zinc oxide. The basic lead sulfate used thus in blending is included in this report in the quantities shown for leaded zinc oxide and not in the figures for basic sulfate.

Distribution of basic lead sulfate sales,[1] 1942–46, by industries, in short tons

Industry	1942	1943	1944	1945	1946
Paints	7,733	4,802	5,496	3,009	
Rubber	89	131	268	200	
Storage batteries		3	2		(2)
Other	588	661	567	686	
	8,410	5,597	6,333	3,895	(2)

[1] Reported as shipments in 1945 and 1946.
[2] Data for basic lead sulfate in 1946 included under white lead; Bureau of Mines not at liberty to show separately.

RED LEAD

The stringent supply situation in pig lead in 1946 was an important factor in the 31 percent drop in shipments of red lead, as demand for this pigment was far from met by supplies in that year. Sales of this

pigment had stayed at high levels throughout the war. Storage batteries and paints, by far the chief uses, both took much less red lead than in 1945, dropping 28 and 43 percent, respectively. Use of red lead in ceramics virtually doubled in 1946 and was at the highest rate since 1941, accounting, however, for only 4 percent of total shipments.

Production of red lead amounted to 29,874 tons in 1946 compared with 48,185 tons in 1945.

The value of red lead as a structural paint was recently described.[7]

See the discussion under Litharge for a recent report on German red lead practice.

Distribution of red lead sales,[1] 1942–46, by industries, in short tons

Industry	1942	1943	1944	1945	1946
Storage batteries	23,545	26,616	30,211	26,725	19,115
Paints	21,017	22,271	18,074	16,438	9,318
Ceramics	939	622	878	626	1,228
Other	2,868	3,869	4,809	3,592	2,865
	48,369	53,378	53,972	47,381	32,526

[1] Reported as shipments in 1945 and 1946.

ORANGE MINERAL

Shipments of the small-tonnage orange mineral were cut almost in half in 1946. Ink manufacture took 63 percent of the total.

Distribution of orange mineral sales,[1] 1942–46, by industries, in short tons

Industry	1942	1943	1944	1945	1946
Ink manufacture	93	49	56	63	78
Color pigments	7	8	205	151	18
Other	28	22	23	16	27
	128	79	284	230	123

[1] Reported as shipments in 1945 and 1946.

LITHARGE

Shipments of litharge fell 4 percent in 1946 from the peak rate established in 1945 but exceeded all earlier years except 1945 and the slightly lower 1944. The serious shortage of lead in 1946 had an important bearing on the lowered rate of production and shipments of litharge in 1946, because manufacturers of litharge were unable to fill demand for their product. Storage batteries took 5 percent less litharge than in 1945, accounting for 57 percent of the total shipments; the quantity used for batteries was exceeded only by the previous year. In addition to the litharge used to make batteries, the storage-battery manufacturers themselves produce from pig lead a black or suboxide of lead which they use as a substitute for litharge. The quantity produced in 1946—46,000 tons—was 18 percent below 1945, marking a considerably greater drop than was registered by litharge. Black oxide figures are not included in the Bureau of

[7] Dunn, E. J., Jr., Physical and Chemical Phenomena That Account for Red Lead's Metal Protective Ability: Paint Industry Mag., vol. 56, No. 10, October 1946, pp. 340, 342, 344–348.

Mines totals for litharge. Insecticides, which have been dropping in the face of gains for other uses, fell 21 percent from 1945, or considerably more than the average. Shipments to makers of ceramics gained 14 percent in 1946 and were the largest since 1941. Use for oil refining and the manufacture of varnish and rubber also moved upward against the trend for total litharge. Chrome pigments, which ranked as the fourth most important use in 1946, declined 5 percent from 1945. Methods of producing certain grades of chrome yellow in Germany were recently discussed.[8]

Litharge production totaled 133,266 tons in 1946 compared with 141,258 tons in 1945.

Distribution of litharge sales,[1] 1942–46, by industries, in short tons

Industry	1942	1943	1944	1945	1946
Storage batteries	43,630	54,984	72,342	79,981	75,836
Insecticides	14,830	20,236	25,957	18,061	14,259
Ceramics	9,525	9,866	12,381	11,511	13,166
Chrome pigments	7,344	9,351	8,233	11,394	10,877
Oil refining	4,771	5,227	5,608	6,419	6,682
Varnish	3,423	3,453	2,988	2,752	3,302
Rubber	3,460	4,302	3,023	1,864	2,131
Linoleum	343	98	117	115	106
Other	4,187	5,574	7,554	6,701	7,440
	91,513	113,091	138,203	138,798	133,799

[1] Reported as shipments in 1945 and 1946.

The manufacture of red lead and litharge in Germany was described in a recent report.[9]

ZINC OXIDE

Shipments of zinc oxide (lead-free) gained 23 percent in 1946, were the largest since 1929, and had been exceeded only in the boom years of 1929 and 1928. All classes of use, except chemical warfare, shared in the larger tonnage; as before the war, none was reported for chemical warfare in 1946. Consumption in rubber, the chief use, rose 32 percent and took 53 percent of the total, or the largest share since 1942, when it also took 53 percent. Paints gained 24 percent in 1946 and were the largest since 1930. Stringent supplies of white lead in the past 3 years, owing to inadequate and falling supplies of lead, have increased the calls for zinc oxide and other white pigments. Floor coverings and textiles made the smallest gain, rising 6 percent. A further break-down of this class was made in 1946, showing that rayon took 73 percent of it in that year. Ceramics rose more than any other use, as in 1945, gaining 78 percent over that year and establishing a new record. This use made the poorest showing during the war but, following the sharp gains in 1945 and 1946, accounted for the same percentage of the total as in the period 1937–40.

Production of lead-free oxide amounted to 142,567 tons compared with 139,374 tons in 1945. Of the total for 1946, 74 percent was made by the American process from ores and primary residues, 20 percent

[8] Office of Military Government for Germany (US), Chrome Yellow and Other Pigments at G. Siegel & Co.: Fiat Final Rept. 811, May 13, 1946, 10 pp.
[9] Office of Military Government for Germany (US), Litharge and Red Lead Process: Fiat Final Rept. 807, May 14, 1946, 18 pp.

by the French process from metal and scrap, and 6 percent by other processes, compared with 77, 17 (revised), and 6 (revised) percent, respectively, in 1945.

The facilities of the International Smelting & Refining Co. at East Chicago, Ind., for the production of white lead and zinc oxide, were purchased by the Eagle-Picher Co. in 1946.

According to a recent statement,[10] zinc pigments are now the most widely used of all white pigments and their use is increasing. The statement apparently refers to the United Kingdom or to some particular region, because titanium pigments rank first in the United States.

Distribution of zinc oxide sales,[1] 1942–46, by industries, in short tons

Industry	1942	1943	1944	1945	1946
Rubber	52,717	67,898	59,518	63,447	83,776
Paints	25,122	29,852	24,999	28,014	34,785
Coated fabrics and textiles	5,224	6,633	9,563	12,177	[2] 10,022
Floor coverings					2,848
Ceramics	2,934	3,203	3,653	5,086	9,056
Chemical warfare		21,801	27,686	2,053	
Other	13,680	14,015	15,256	17,178	17,364
	99,677	143,402	140,675	127,955	157,851

[1] Reported as shipments in 1945 and 1946.
[2] Of which 9,363 tons were for rayon.

LEADED ZINC OXIDE

Leaded zinc oxide shipments in 1946 were second only to those in 1941, being 1 percent below the peak year. It has been pointed out previously that this pigment's advantageous position during the war stemmed from the fact that it is made almost exclusively from ore rather than scarcer metal or scrap. Shipments of leaded zinc oxide for paint have been at high levels for several years, partly because of the diversion of business from other white pigments in smaller supply. This pigment continued to be used almost exclusively for paint. The figures for leaded zinc oxide include basic lead sulfate used in blending, as indicated under Basic Lead Sulfate.

Leaded zinc oxide production totaled 71,016 tons in 1946 compared with 62,519 tons in 1945. The totals can be broken down as follows (comparison with 1945 in parentheses): Over 5–35 percent lead, 59,564 (48,678) tons; over 35–50 percent, 7,150 (10,091 and a revised total of 10,057 for 1944) tons; and most of the remainder in 1946 was over 50 percent lead and in 1945 was 5 percent or less.

Distribution of leaded zinc oxide sales,[1] 1942–46, by industries, in short tons

Industry	1942	1943	1944	1945	1946
Paints	47,052	42,303	62,223	58,852	64,816
Rubber		42	119	200	166
Other	1,076	1,483	2,053	3,546	2,989
	48,128	43,828	64,395	62,598	67,971

[1] Reported as shipments in 1945 and 1946.

[10] Metal Bulletin (London), No. 3142, November 5, 1946, p. 17.

LITHOPONE

The lithopone statistics in this report are given on the basis of ordinary lithopone sold as such plus the ordinary lithopone content of the high-strength product. This method of publication is used to conceal the operations of one company, which always dominates the output of the high-strength product and has been the only producer in some years. In 1946, as in 1945, two companies, operating three plants, produced high-strength lithopone. Shipments of lithopone increased 8 percent in 1946 and were the largest since 1941, but were insufficient to supply total demand. Sales to manufacturers of paints gained 13 percent—more than the total gain—whereas those to makers of floor coverings and textiles were slightly lower than in 1945. Rubber manufacturers took 64 percent more than in 1945 but accounted for only 1 percent of the total. Separation of the lithopone shipped for floor coverings and textiles shows that 7,626 tons were for coated fabrics and textiles and 7,541 for floor coverings, compared with 5,150 and 10,671 tons respectively, in 1945. Prior to 1946 the break-down of statistics on floor coverings and textiles was partly estimated; the actual break-down for 1945, therefore, may have been closer to that for 1946 than is apparent. The use of lithopone by paper manufacturers, which had been rising prior to 1945, continued at about the 1945 rate in 1946; it amounted to 3,011 tons compared with 3,086 tons in 1945 and contrasted with 6,488 tons in 1944. Shipments reported for use in ink manufacture likewise dropped in 1945 and continued relatively unchanged in 1946. The tonnages were 1,216 in 1944, 864 in 1945, and 830 in 1946. A tonnage sold for use in making ink is regularly shown by one manufacturer as not separable from that sold for paint, but the tonnages given here are for identical companies. Exports are included mainly under Other, but at least one company classifies part of its exports according to end use.

Plant capacity for the manufacture of lithopone was reported to total 157,000 tons in 1946.

Production of lithopone amounted to 148,926 tons in 1946 compared with 136,460 tons in 1945.

Distribution of lithopone sales,[1] 1942–46, by industries, in short tons

Industry	1942	1943	1944	1945	1946
Paints, varnishes, and lacquers[2]	109,216	103,860	108,800	109,398	123,279
Floor coverings and textiles	15,775	15,999	14,746	15,821	15,167
Rubber	1,047	1,078	726	977	1,607
Other	11,282	14,786	18,633	9,965	6,948
	137,320	135,723	142,905	136,161	147,001

[1] Reported as shipments in 1945 and 1946.
[2] Includes a quantity, not separable, used for printing ink.

Consumption of ordinary lithopone in the production of titanated lithopone has trended downward almost continuously since the peak, 19,400 tons, was used in 1937. In 1946, 6,350 tons were used for this purpose or slightly below one-third of the all-time high record. The

lithopone figures in the following table are included in the totals for ordinary lithopone in the preceding table.

Titanated lithopone produced in the United States and ordinary lithopone used in its manufacture, 1942–46, in short tons

Year	Titanated lithopone produced	Ordinary lithopone used	Year	Titanated lithopone produced	Ordinary lithopone used
1942	11,700	9,900	1945	9,200	7,800
1943	9,800	8,400	1946	7,500	6,350
1944	9,800	8,300			

ZINC SULFIDE

In 1946, as in several earlier years, only one company produced zinc sulfide, and the Bureau of Mines is not at liberty, therefore, to publish figures for this pigment.

ZINC CHLORIDE

Shipments of zinc chloride, in terms of 50° B. solution, totaled 57,316 tons in 1946 compared with 56,230 tons in 1945. These figures include the zinc chloride equivalent of zinc ammonium and chromated zinc chloride produced. Complete figures covering distribution of zinc chloride shipments by uses are not available.

Production amounted to 57,088 tons in 1946 and 56,793 tons in 1945.

ZINC SULFATE

Zinc sulfate shipments established a new high record in 1946, for the second successive year, rising 20 percent above 1945. The curve of zinc sulfate shipments has increased sharply during the past 10 years or more, the total for 1946 being 171 percent above the average for the 5-year period, 1935–39. Agriculture led other uses by a substantial margin in 1946, taking 43 percent of the total, and displaced rayon, with 31 percent, which stood first in 1945. Both uses established new peak records in 1946, the former gaining 63 percent over 1945 and the latter, 13 percent. Chemicals, flotation reagent, and paints all dropped in 1946, the last being only 7 percent of the quantity reported in 1943. If a more complete break-down of the chemicals classification were practicable, some of the other classifications probably would be increased. Electrogalvanizing and the manufacture of glue showed substantial gains in 1946, the former taking the largest tonnage since 1941.

The dry weight of zinc sulfate shipments, by uses, was reported for the first time in 1945. In compiling data for 1946, the 1945 figures were found to require revision and necessary changes are covered in the accompanying table.

In 1946, 25,004 tons of zinc sulfate were produced, compared with 21,362 tons in 1945.

Distribution of zinc sulfate sales,[1] 1942–46, by industries, in short tons

Industry	1942	1943	1944	1945		1946	
	Gross weight	Gross weight	Gross weight	Gross weight	Dry basis[2]	Gross weight	Dry basis
Agriculture	4,123	3,329	4,974	6,645	5,062	10,816	8,178
Rayon	3,149	4,537	5,954	6,729	5,393	7,634	5,883
Chemicals	2,595	1,642	1,459	2,617	1,749	2,254	1,488
Flotation reagent	355	1,282	1,131	1,232	935	1,084	643
Textile dyeing and printing	60	213		534	474	552	491
Glue	750	635	293	260	186	511	335
Electrogalvanizing	219	187	278	255	161	488	315
Paints and varnish processing	1,917	2,439	1,330	589	539	174	151
Other	1,163	1,385	1,737	1,993	1,342	1,418	943
	14,331	15,649	17,156	20,854	15,841	24,931	18,427

[1] Reported as shipments in 1945 and 1946.
[2] Revised figures.

PRODUCERS AND PLANTS

The report of this series for 1945 contained a list of producers of lead and zinc pigments and zinc salts of their own manufacture, by classes of product. Since this list was prepared, the white lead and zinc oxide facilities of the International Smelting & Refining Co. at East Chicago, Ind., have been taken over by the Eagle-Picher Co.

RAW MATERIALS USED IN MANUFACTURE OF LEAD AND ZINC PIGMENTS AND ZINC SALTS

Figures covering the raw materials used in making pigments and salts were not available when the report of this series for 1945 was prepared. Data for 1945 are given below, and those for 1946 will appear in the next annual issue of this volume.

Lead pigments and zinc pigments and salts are manufactured from a variety of materials, including ore, refined metal, and such secondary materials as scrap. In 1945, 92 percent of the lead in pigments was derived from pig lead and 8 percent from ore. Of the lead in ore used to make leaded zinc oxide, about 9 percent was from foreign sources. The proportion for zinc pigments in 1945 was 76 percent from ore and concentrates, 9 percent from slab zinc, and 15 percent from secondary materials; about 20 percent of the ore used was foreign.

The following tables give the source of the metal used in the manufacture of each pigment and salt. Pig lead is employed exclusively, either directly or indirectly, in the manufacture of white lead, litharge, red lead, and orange mineral and is used also in the manufacture of basic lead sulfate. The lead content of leaded zinc oxide made from basic lead sulfate, which in turn was made from pig lead, is credited to pig lead in the table. Zinc oxide is the only pigment in which considerable slab zinc is used. Ore is employed in the manufacture of zinc oxide, leaded zinc oxide, lithopone, zinc sulfide, zinc sulfate, and basic lead sulfate. A substantial proportion of the zinc in litho-

pone (46 percent in 1945) and most of that in zinc chloride made in the United States are derived from secondary material. For a number of years before the United States entered World War II, there had been a large increase in the quantity of secondary zinc used in the manufacture of zinc oxide. The scarcity of supplies of both metal and scrap caused the proportion of the total oxide made by the French process, which uses only metal and scrap, to drop sharply in 1942 and to continue low in 1943–45, despite the fact that the percentage from metal and scrap rose in 1943 and continued upward in 1944 and 1945. The production of zinc oxide from metal and scrap accounted for the following percentages in relation to total production: 41 percent in 1939, 16 percent in 1942, 19 percent in 1943, 22 percent in 1944, and 25 percent in 1945.

Lead content of lead and zinc pigments produced by domestic manufacturers, 1944–45, by sources, in short tons

Pigment	1944					1945				
	Lead in pigments produced from—				Total lead in pigments	Lead in pigments produced from—				Total lead in pigments
	Ore		Pig lead	Secondary material		Ore		Pig lead	Secondary material	
	Domestic	Foreign				Domestic	Foreign			
White lead			61,143		61,143			39,742		39,742
Red lead			48,411		48,411			43,685		43,685
Litharge			136,353		136,353			131,116		131,116
Orange mineral			254		254			196		196
Basic lead sulfate	2,709		710		3,419	2,807		327		3,134
Leaded zinc oxide	14,975	2,063	354		17,392	14,436	1,453	529	1	16,419
	17,684	2,063	247,225		266,972	17,243	1,453	215,595	1	234,292

Zinc content of zinc pigments and salts produced by domestic manufacturers, 1944–45, by sources, in short tons

Pigment or salt	1944					1945				
	Zinc in pigments and salts produced from—				Total zinc in pigments and salts	Zinc in pigments and salts produced from—				Total zinc in pigments and salts
	Ore		Slab zinc	Secondary material [1]		Ore		Slab zinc	Secondary material [1]	
	Domestic	Foreign				Domestic	Foreign			
Zinc oxide	85,075	10,186	15,198	11,376	121,835	65,505	18,240	15,462	12,161	111,368
Leaded zinc oxide	26,893	5,141		620	32,654	25,395	4,197		706	30,298
Lithopone	9,427	2,929		13,979	26,335	11,474	2,998		12,207	26,679
Total pigments [2]	121,395	18,256	15,198	25,975	180,824	102,374	25,435	15,462	25,074	168,345
Zinc chloride			13	12,560	12,573			22	12,472	12,494
Zinc sulfate	1,607	998	36	2,410	5,051	2,383	808	34	3,289	6,514

[1] These figures are higher than those shown in the report on Secondary Metals—Nonferrous because they include zinc recovered from byproduct sludges, residues, etc., not classified as purchased scrap material.
[2] Excludes zinc sulfide, data for which Bureau of Mines not at liberty to publish.

PRICES

Total and average values received by producers for lead and zinc pigments and zinc salts are given in the tables in the first part of this report. Average values for all pigments gained markedly in 1946. Following the raising of the ceiling price on pig lead, the OPA prices for pigments and pastes with a high lead content were increased, effective June 7, 1946—the first advance since maximum prices were established by the General Maximum Price Regulation in 1942. The changes represented an average increase over previous maximum prices of 20 percent, or about 1¼ cents a pound.

Producers raised prices for zinc oxide (lead-free and leaded) above ceilings in June 1946 during the almost month-long interim in the operation of the OPA. Ceiling prices at March and June 1942 levels were reestablished at the end of July and were increased by the OPA for the first time on October 14.

All price controls on the products covered by this report were removed by general order of the President, effective November 10. Immediate gains were 2¼ cents a pound for litharge, white lead, and red lead, 1 cent a pound for zinc oxide (lead-free), 1 to 1¾ cents a pound for the leaded grades of zinc oxide (depending on lead content), and less than ¾ cent for lithopone. Further gains were established before the end of the year, when prices for pigments covered by this report were at the highest rates for many years and for lead pigments the highest ever recorded.

Range of quotations on lead pigments and zinc pigments and salts at New York (or delivered in the East), 1943–46, in cents per pound

[Oil, Paint and Drug Reporter]

Product	1943	1944	1945	1946
Basic lead sulfate, or sublimed lead, less than carlots, barrels	7.50–7.75	7.50–7.75	7.50–7.75	7.50–13.50
White lead, or basic lead carbonate, dry, carlots, barrels	8.25	8.25	8.25	8.25–13.75
Litharge, commercial, powdered, barrels	8.00–9.00	8.00–9.00	8.00–9.00	8.00–14.75
Red lead, dry, 95 percent or less, less than carlots, barrels	9.50–10.00	9.50–10.00	9.50–10.00	9.50–16.00
Orange mineral, American, small lots, barrels	12.00–12.50	12.00–12.50	12.00–12.50	12.00–18.25
Zinc oxide:				
American process, lead-free, bags, carlots	7.25	7.25	7.25	7.25–9.00
American process, 5 to 35 percent lead, barrels, carlots	7.25–7.38	7.25–7.38	7.25–7.38	7.25–10.75
French process, red seal, bags, carlots	8.50	8.50	8.50	8.50–10.25
French process, green seal, bags, carlots	9.00	9.00	9.00	9.00–10.75
French process, white seal, barrels, carlots	9.75	9.75	9.75	9.75–12.00
Lithopone, ordinary, small lots, bags	4.50	4.50	4.50	4.50–5.25
Zinc sulfide, less than carlots, bags, barrels	8.50–8.75	8.50–8.75	8.50–8.75	8.50–10.00
Zinc chloride, works:				
Solution, tanks	2.50	2.50	2.50	2.50
Fused, drums	5.00–6.50	5.00–6.50	5.00–6.50	5.00–6.50
Zinc sulfate, crystals, barrels	3.85–4.60	[1] 3.65–4.60	[1] 3.65–4.40	[1] 3.65–4.40

[1] Quotation was reduced to 3.65–4.40 cents per pound in Sept. 11, 1944, issue of the Oil, Paint and Drug Reporter, which added "works, freight allowed," to the description.

FOREIGN TRADE [11]

The total value of exports of lead and zinc pigments and salts in 1946 was 13 percent below 1945, accounted for in part by the dropping of several small items from that classification. The total for 1946

[11] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

was well in advance of any year in the 1929–41 period and also exceeded 1942 and 1944. The tonnages of zinc oxide and lithopone each exceeded any lead class several times, and the value of zinc pigments exported was 3.4 times that for the lead group. Zinc pigments exported rose 28 percent in value, while lead pigments declined 40 percent.

Value of foreign trade of the United States in lead and zinc pigments and salts, 1945–46

	1945		1946	
	Imports	Exports	Imports	Exports
Lead pigments:				
White lead	$54	$611,688	$339	$183,857
Red lead		385,563	3,806	292,451
Litharge	1,566	414,167	4,576	374,583
Orange mineral		920		(1)
Other lead pigments	5,997	8,831	4,312	(1)
	7,617	1,421,169	13,033	850,891
Zinc pigments:				
Zinc oxide	24	1,203,361	8,426	2,022,902
Lithopone	7	1,049,961	58	888,555
Zinc sulfide		25,399	324	(1)
	31	2,278,721	8,808	2,911,457
Lead and zinc salts:				
Lead arsenate		735,065	5	333,981
Other lead compounds	18	(2)		(2)
Zinc chloride		93,590	495	(1)
Zinc sulfate	16,775	62,119	17,225	(1)
Other zinc salts and compounds	(2)	119,747	(2)	(1)
	16,793	1,010,521	17,725	333,981
Grand total	24,441	4,710,411	39,566	4,096,329

[1] Beginning Jan. 1, 1946, not separately classified.
[2] Data not available.

Lead Pigments and Salts.—Imports of lead pigments are of little consequence, red lead, amounting to 54 tons, being the chief item in 1946. All classes shown separately in the export group were shipped from the United States in smaller quantity in 1946 than in 1945; white lead, the chief class in 1945, with 4,079 tons, dropped to only 910 tons in 1946 or to the lowest level in many years. Litharge, lead arsenate, and red lead ranked above white lead in tonnage in 1946. Red lead exports amounted to 4 percent of total domestic shipments in 1946, or the highest proportion attained by any lead pigment.

Lead pigments and salts imported for consumption in the United States, 1942–46

Year	Short tons					Total value
	Basic carbonate white lead	Red lead	Litharge	Suboxide of lead	Other lead compounds	
1942		2	2	7	11	$5,841
1943		4	1	3		3,349
1944	(1)		1	10		5,962
1945	1		8	10	(1)	7,635
1946	1	54	15	11		[2] 13,038

[1] Less than 1 ton.
[2] Includes also lead pigments, n. s. p. f., $97 (522 pounds); lead arsenate, $5 (552 pounds).

Lead pigments and salts exported from the United States, 1942–46

Year	Short tons						Total value
	White lead	Red lead	Litharge	Orange mineral	Sublimed lead	Lead arsenate	
1942	2,249	1,391	1,999	7	95	296	$1,030,472
1943	4,692	1,535	1,610	7	71	1,527	1,814,612
1944	3,052	2,117	2,391	13	82	2,133	1,888,129
1945	4,079	1,922	2,512	3	53	3,170	2,156,234
1946	910	1,355	2,180	(1)	(1)	1,398	1,184,872

[1] Beginning Jan. 1, 1946, not separately classified.

Zinc Pigments and Salts.—Zinc sulfate continued to be the chief item in the import class but amounted to only 415 tons. Exports of zinc oxide gained 54 percent in 1946 and were the largest since 1929, exceeding shipments of lithopone from the United States for the first time since 1937, when exports of these pigments were 2,953 and 2,671 tons, respectively. Lithopone exports were only half of the high record tonnage for 1941, having dropped almost continuously thereafter; the 1946 tonnage was the smallest since 1939. Zinc oxide and lithopone exports each amounted to 7 percent of the total shipments by domestic producers.

Zinc sulfate had been the chief zinc chemical compound exported until 1945, when it was surpassed in quantity and value by zinc chloride. Separate data on these compounds are not available after January 1, 1946.

Zinc pigments and salts imported for consumption in the United States, 1942–46

Year	Short tons						Total value
	Zinc oxide		Lithopone	Zinc sulfide	Zinc chloride	Zinc sulfate	
	Dry	In oil					
1942	13	1	----	1	----	362	$26,390
1943	10	11	----	----	----	546	34,033
1944	(1)	5	----	(1)	----	542	30,220
1945	(1)	----	(1)	----	----	421	16,806
1946	41	----	(1)	(1)	2	415	26,528

[1] Less than 1 ton.

Zinc pigments and salts exported from the United States, 1942–46

Year	Short tons		Total value [1]	Year	Short tons		Total value [1]
	Zinc oxide	Lithopone			Zinc oxide	Lithopone	
1942	6,013	17,036	$2,913,595	1945	7,102	11,576	$2,554,177
1943	6,019	17,320	2,898,253	1946	10,955	9,651	2,911,457
1944	5,511	11,551	2,194,203				

[1] Includes also—1942: Zinc sulfide $6,328 (37,691 pounds); zinc chloride, $42,674 (648,343 pounds); zinc sulfate, $53,624 (1,025,554 pounds); other zinc salts and compounds, $76,023 (519,458 pounds); 1943: Zinc sulfide, $29,523 (78,387 pounds); zinc chloride $57,390 (751,861 pounds); zinc sulfate $81,750 (1,830,508 pounds); other zinc salts and compounds, $22,087 (139,940 pounds); 1944: Zinc sulfide, $7,195 (40,223 pounds); zinc chloride, $47,133 (711,953 pounds); zinc sulfate, $83,566 (2,029,801 pounds); other zinc salts and compounds, $46,587 (167,474 pounds); 1945: Zinc sulfide, $25,399 (173,475 pounds); zinc chloride, $93,590 (1,499,755 pounds); zinc sulfate $62,199 (1,243,826 pounds); other zinc salts and compounds, $119,747 (750,108 pounds); 1946: Beginning January 1 none of the foregoing classes separately recorded.

Lime

By CHARLES L. HARNESS AND F. D. GRADIJAN

GENERAL SUMMARY

RECONVERSION to a peacetime economy caused a general shifting in the lime end-use pattern, with declines in sales to the refractory, chemical, and industrial markets and compensating increases in building and agricultural sales. Total lime sales in 1946—5,992,700 short tons—which exceeded those of 1945 by 1 percent, were 9 percent below the historical record set in 1943. Quicklime represented 72 percent and hydrated lime 28 percent of the total sales, compared with 77 and 23 percent, respectively, in 1945.

The prices of lime (except agricultural lime) were controlled by the Office of Price Administration under Maximum Price Regulation 592 until November 10, 1946, the effective date of removal of control by the Price Administrator. The average price per ton of quicklime advanced from $7.56 a short ton in 1945 to $8.27 in 1946; similarly, hydrated lime advanced from $8.43 to $9.15. The advance was due to numerous increases authorized by the OPA.

Salient statistics of the lime industry in the United States, 1925–29 (average), 1935–39 (average), and 1944–46

	1925–29 (average)	1935–39 (average)	1944	1945	1946
Active plants	419	310	210	189	182
Sold by producers:					
By types:					
Quicklime, short tons	2,871,236	2,488,269	5,150,545	4,565,551	4,344,331
Hydrated, do	1,585,631	1,204,128	1,323,018	1,355,028	1,648,369
Total lime:					
Short tons	4,456,867	3,692,397	6,473,563	5,920,579	5,992,700
Value [1]	$38,548,498	$26,592,115	$48,698,162	$45,918,468	$51,032,517
Per ton	$8.65	$7.20	$7.52	$7.76	$8.52
By uses:					
Agricultural, short tons	318,224	350,535	466,390	373,410	384,658
Building, do	2,096,744	870,335	520,000	549,547	845,604
Chemical and industrial, do	1,623,885	1,929,947	4,196,383	3,810,288	3,684,455
Refractory (dead-burned dolomite), short tons	418,014	541,580	1,290,790	1,187,334	1,077,983
Imported for consumption:					
Short tons	18,683	14,108	17,788	20,858	25,275
Value	$344,887	$240,909	$151,420	$179,210	$256,849
Exported:					
Short tons	15,752	10,905	22,689	24,276	33,540
Value	$221,177	$123,167	$216,642	$268,875	$423,948

[1] Selling value, f. o. b. plant, excluding cost of containers.

In 1945 the labor shortage curtailed lime output. During 1946 labor was generally available, but the boxcar shortage hampered sales. Shipments of finishing lime were particularly short, owing partly to insufficient shipping space and partly to an exceptionally high demand.

During the war, building-lime sales, which generally follow the trend of total new construction, fell far below the curve owing to the small lime requirements for temporary construction. In 1946, however, building lime again followed the curve of new construction, as may be noted in figure 1.

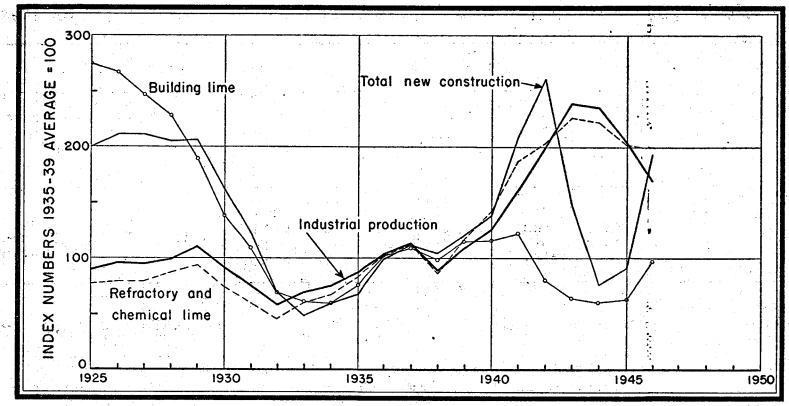

FIGURE 1.—Sales of refractory and building lime compared with total new construction and industrial production, 1925–46. Units are reduced to percentages of the 1935–39 average. Statistics on value of construction from the Bureau of Foreign and Domestic Commerce and on industrial production from the Federal Reserve Board.

Trends in sales of "open-market" lime for its principal uses during the past 22 years are indicated in figure 2. Sales of chemical lime and refractory lime (dead-burned dolomite) since 1925 have followed a course closely parallel. Building lime spurted upward. Agricultural lime was up 3 percent.

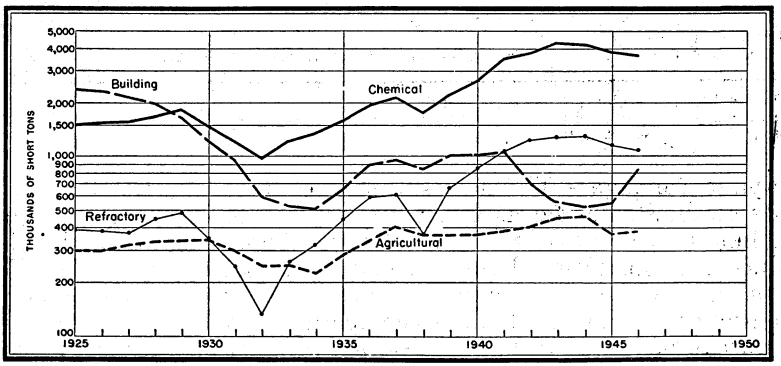

FIGURE 2.—Trends in major uses of lime, 1925–46.

PRODUCTION

Production (sales) of building and agricultural lime increased in 1946 over 1945, whereas chemical, industrial, and refractory uses were down.

As quicklime is a semiperishable commodity and most plants have negligible warehousing facilities, stocks held by producers are generally small. Thus, in this chapter the quantities of "open-market" lime sold or used are considered equivalent to production and are used interchangeably.

Lime sold by producers in the United States, 1945–46, by types and major uses

	1945				1946					
	Quantity		Value [1]		Quantity		Value [1]		Percent change from 1945 in—	
	Short tons	Percent of total	Total	Average	Short tons	Percent of total	Total	Average	Tonnage	Average value
By types:										
Quicklime	4,565,551	77	$34,496,214	$7.56	4,344,331	72	$35,949,118	$8.27	−5	+9
Hydrated lime	1,355,028	23	11,422,254	8.43	1,648,369	28	15,083,399	9.15	+22	+9
Total lime [2]	5,920,579	100	45,918,468	7.76	5,992,700	100	51,032,517	8.52	+1	+10
By uses:										
Agricultural:										
Quicklime	120,529	2	827,920	6.87	113,486	2	899,677	7.93	−6	+15
Hydrated lime	252,881	4	2,078,924	8.22	271,172	5	2,251,936	8.30	+7	+1
	373,410	6	2,906,844	7.78	384,658	7	3,151,613	8.19	+3	+5
Building:										
Quicklime	115,521	2	1,147,021	9.93	206,055	3	2,350,760	11.41	+78	+15
Hydrated lime	434,026	8	3,762,343	8.67	639,549	11	6,275,938	9.81	+47	+13
	549,547	10	4,909,364	8.93	845,604	14	8,626,698	10.20	+54	+14
Chemical and industrial:										
Quicklime	3,142,167	53	21,907,562	6.97	2,946,807	49	22,596,974	7.67	−6	+10
Hydrated lime	668,121	11	5,580,987	8.35	737,648	12	6,555,525	8.89	+10	+6
	3,810,288	64	27,488,549	7.21	3,684,455	61	29,152,499	7.91	−3	+10
Refractory (dead-burned dolomite)	1,187,334	20	10,613,711	8.94	1,077,983	18	10,101,707	9.37	−9	+5

[1] Selling value, f. o. b. plant, excluding cost of container.
[2] Includes lime used by producers (captive tonnage) as follows—1945: 368,572 tons, valued at $2,216,373; 1946: 328,837 tons, valued at $2,216,551.

Captive Tonnage.—The lime statistics compiled by the Bureau of Mines are limited as far as possible to returns of operators who produce lime for sale to consumers. Captive tonnage of companies that produce lime for internal consumption is excluded, with only a few exceptions. Hence, the annual review figures are confined largely to "open-market" lime sold under competitive conditions. However, the Bureau of Mines attempts to obtain complete figures on the con-

sumption of lime in certain uses, irrespective of whether it was "open-market" or captive lime, and thus some captive tonnage appears in the sales figures. The accompanying data showing lime sold or used by producers in the United States in 1946 include 328,837 short tons of captive tonnage, as follows: 9,200 short tons for prepared masonry mortars and mason's lime, 208,186 tons for metallurgical uses (about equally divided between steel manufacture and ore concentration), 56,840 tons for miscellaneous chemical uses, and 54,611 tons of refractory lime. Total captive tonnage, including the above quantity, may be determined approximately by adding together all the figures in the limestone-use table (see the Stone chapter of this volume) that have the same use listing as the lime-use table, including "alkali," "calcium carbide," "glass," "magnesia," "paper," "refractory," and "sugar"; an allowance should be made, of course, for loss of weight when limestone is calcined to lime. In some of these uses, some limestone is used without calcining; so precise captive-lime data cannot be compiled.

Size of Plants.—The progressive decline in the number of plants operating continued in 1946. The 182 producers in 1946 contrast strikingly with the 450 in 1925, when production was only about three-fourths as great. The decline in the number of active plants is most pronounced in the groups of smaller operations, particularly in the group producing less than 1,000 tons a year.

Distribution of lime (including refractory) plants, 1944–46, according to size of production

Size group (short tons)	1944			1945			1946		
	Plants	Production		Plants	Production		Plants	Production	
		Short tons	Percent of total		Short tons	Percent of total		Short tons	Percent of total
Less than 1,000	25	10,929	(1)	27	11,448	(1)	19	7,708	(1)
1,000 to less than 5,000	45	120,763	2	38	109,488	2	43	115,786	2
5,000 to less than 10,000	28	194,032	3	22	153,868	3	20	145,782	3
10,000 to less than 25,000	35	532,642	8	29	480,582	8	28	427,514	7
25,000 to less than 50,000	35	1,267,897	20	35	1,267,909	21	30	1,104,538	18
50,000 to less than 100,000	27	1,788,065	28	24	1,544,176	26	27	1,759,109	29
100,000 and over	15	2,559,235	39	14	2,353,108	40	15	2,432,263	41
	210	6,473,563	100	189	5,920,579	100	182	5,992,700	100

[1] Less than 1 percent.

PRODUCTION BY STATES

In 1946 "open-market" lime was produced in 34 States and 2 Territories. The leading producers were Ohio, Pennsylvania, Missouri, and West Virginia, which together supplied 61 percent of the total. Ohio alone contributed 25 percent.

Lime (quick and hydrated) sold by producers in the United States, 1945–46, by States

State or Territory	1945			1946		
	Active plants	Short tons	Value	Active plants	Short tons	Value
Alabama	7	315,559	$2,076,768	7	294,654	$2,164,209
Arizona	3	58,736	522,609	3	50,354	489,091
Arkansas	1	(1)	(1)	1	(1)	(1)
California	9	135,158	1,515,497	9	172,623	2,144,712
Colorado	2	(1)	(1)	2	(1)	(1)
Connecticut	1	(1)	(1)	1	(1)	(1)
Florida	3	18,431	211,077	2	(1)	(1)
Georgia	1	3,864	32,797	1	2,691	33,251
Hawaii	1	8,114	130,085	1	7,824	172,404
Illinois	7	287,607	2,229,335	7	280,051	2,365,455
Indiana	1	(1)	(1)	1	(1)	(1)
Louisiana	1	(1)	(1)	1	(1)	(1)
Maine	2	(1)	(1)	2	(1)	(1)
Maryland	7	66,675	502,376	9	83,580	692,262
Massachusetts	3	94,499	816,733	4	117,709	1,136,428
Michigan	3	(1)	(1)	3	(1)	(1)
Minnesota	1	(1)	(1)	1	(1)	(1)
Missouri	10	753,932	5,031,222	9	799,742	5,931,485
Montana	2	(1)	(1)	2	(1)	(1)
Nevada	2	(1)	(1)	2	(1)	(1)
New Jersey	3	(1)	(1)	3	(1)	(1)
New Mexico	1	(1)	(1)			
New York	3	(1)	(1)	3	(1)	(1)
North Carolina	1	(1)	(1)			
Ohio	18	1,420,983	11,693,615	18	1,469,278	12,926,310
Oklahoma	1	(1)	(1)	1	(1)	(1)
Oregon	1	(1)	(1)	1	(1)	(1)
Pennsylvania	31	903,914	7,221,808	28	972,311	8,272,202
Puerto Rico	5	7,504	173,643	4	(1)	(1)
South Dakota	2	(1)	(1)	2	(1)	(1)
Tennessee	8	207,587	1,373,268	6	160,698	1,232,480
Texas	7	105,277	807,332	7	121,841	1,053,493
Utah	5	47,484	353,671	6	29,057	271,526
Vermont	4	38,096	267,478	3	(1)	(1)
Virginia	15	118,707	835,575	13	181,282	1,365,931
Washington	2	(1)	(1)	2	(1)	(1)
West Virginia	6	511,509	3,620,401	8	409,952	3,103,183
Wisconsin	9	124,560	988,422	9	74,686	760,432
Undistributed [1]		692,383	5,514,756		764,367	6,917,663
	189	5,920,579	45,918,468	182	5,992,700	51,032,517

[1] Figures that may not be shown separately are combined as "Undistributed."

Hydrated Lime.—Lime is sold either quick or hydrated. Sales of hydrated lime were reported by 120 plants in 1946 (125 in 1945) in 33 States and 2 Territories. Although the user must pay freight on 24 pounds of water for each 100-pound sack of hydrated lime he buys, for some uses lime hydrated at the mill with precision machinery and skilled workmen is far preferable to quicklime hydrated on the job by unskilled workmen. This is especially true when time is a factor, because for best results the lime should be allowed to slake a few days. Imperfectly slaked lime used in a wall plaster will gradually rehydrate within the plaster, and the volume change will cause pitting in the wall.

Hydrated lime sold by producers in the United States, 1945–46, by States

State or Territory	1945			1946		
	Active plants	Short tons	Value	Active plants	Short tons	Value
Alabama	5	38,230	$363,676	5	41,219	$422,101
California	7	38,748	485,482	7	47,642	624,104
Georgia	1	3,540	28,035	1	2,691	33,251
Hawaii	1	8,105	129,680	1	7,812	171,864
Illinois	5	34,780	268,729	4	39,464	333,956
Maryland	5	34,653	259,508	6	37,575	302,239
Massachusetts	(1)	(1)	(1)	4	54,627	489,480
Missouri	8	190,861	1,439,524	7	207,140	1,713,821
Ohio	14	359,078	2,832,982	14	454,271	4,033,255
Pennsylvania	12	250,972	2,189,738	11	329,525	2,968,590
Tennessee	6	47,889	388,361	6	51,813	454,252
Texas	5	38,896	355,735	5	46,026	460,409
Virginia	10	41,247	336,070	9	46,652	416,829
West Virginia	4	39,635	260,554	5	56,536	405,425
Other States [2]	[2] 42	228,394	2,084,180	[2] 35	225,376	2,253,823
	125	1,355,028	11,422,254	120	1,648,369	15,083,399

[1] Included with "Other States."

[2] Includes the following States and numbers of plants in 1946 (1945 same as 1946 unless shown differently in parentheses): Arizona 1, Arkansas 1, Colorado 1, Connecticut 1, Florida 1 (2), Indiana 1, Louisiana 1, Maine 2, Michigan 1 (2), Minnesota 1, Montana 1, Nevada 1, New Jersey 3, New York 3, North Carolina 0 (1), Oklahoma 1 (0), Oregon 0 (1), Puerto Rico 2, South Dakota 1, Utah 2, Vermont 2 (3), Washington 2, and Wisconsin 6. Massachusetts is included with "Other States" in 1945 (3) but shown separately in 1946.

SALES BY USES

Sales of lime for its varied uses in 1946 shifted from the wartime pattern of 1942–45 and approached a peacetime distribution. There were declines in some large industries, but the increases in customary civilian industries—especially construction—brought total shipments over the 1945 total.

Lime (quick and hydrated) sold by producers in the United States in 1946, by States and uses

State or Territory	Agricultural		Building		Chemical and industrial										Refractory		Total	
					Metallurgical		Paper mills		Tanneries		Water purification		Other					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	671	$5,409	49,928	$411,851	120,301	$744,767	85,566	$631,550	(1)	(1)	11,208	$117,545	(1)	(1)	(1)	(1)	294,654	$2,164,209
Arizona			(1)	(1)	42,417	386,461					(1)	(1)	(1)	(1)			50,354	489,091
Arkansas			(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)			(1)	(1)
California	1,497	18,231	61,131	924,330	24,088	192,035	5,476	85,287	988	$13,709	12,133	120,912	(1)	(1)	(1)	(1)	172,623	2,144,712
Colorado	(1)	(1)	(1)	(1)	(1)	(1)					(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Connecticut	(1)	(1)	(1)	(1)			(1)	(1)									(1)	(1)
Florida			(1)	(1)							(1)	(1)	(1)	(1)			(1)	(1)
Georgia	321	3,993	2,370	29,258													2,691	33,251
Hawaii			1,121	24,938									6,703	$147,466			7,824	172,404
Illinois	(1)	(1)	19,198	236,796	103,591	752,198	(1)	(1)	(1)	(1)	33,162	267,288	(1)	(1)	(1)	(1)	280,051	2,365,455
Indiana	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
Louisiana			(1)	(1)							(1)	(1)	(1)	(1)			(1)	(1)
Maine	(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
Maryland	(1)	(1)	(1)	(1)													83,580	692,262
Massachusetts	9,595	80,683	41,533	416,549	(1)	(1)	13,079	128,454	(1)	(1)	(1)	(1)	36,611	352,768			117,709	1,136,428
Michigan	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
Minnesota	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
Missouri			42,280	399,461	104,641	710,287	(1)	(1)	(1)	(1)	112,588	877,970	432,943	3,069,938	(1)	(1)	799,742	5,931,485
Montana			(1)	(1)	(1)	(1)							(1)	(1)			(1)	(1)
Nevada			(1)	(1)	(1)	(1)					(1)	(1)	(1)	(1)			(1)	(1)
New Jersey	(1)	(1)	(1)	(1)									(1)	(1)			(1)	(1)
New York	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
Ohio	52,510	410,146	352,535	3,239,887	82,318	566,947	24,113	160,747			(1)	(1)	(1)	(1)	651,434	$6,164,696	1,469,278	12,926,310
Oklahoma					(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)			(1)	(1)
Oregon													(1)	(1)			(1)	(1)
Pennsylvania	160,677	1,386,141	64,015	718,015	215,529	1,679,245	76,610	600,152	35,598	276,695	55,163	464,450	(1)	(1)	(1)	(1)	972,311	8,272,202
Puerto Rico			(1)	(1)							(1)	(1)	(1)	(1)			(1)	(1)
South Dakota			(1)	(1)	(1)	(1)					(1)	(1)					(1)	(1)
Tennessee	2,646	20,264	14,719	142,248	15,619	117,940	52,206	378,969	2,106	16,582	27,391	204,754	46,011	351,723			160,698	1,232,480
Texas	(1)	(1)	41,264	396,783	13,122	103,052	18,375	124,546			33,852	291,748	(1)	(1)			121,841	1,053,493
Utah			5,235	79,684	22,384	170,818					(1)	(1)	(1)	(1)			29,057	271,526
Vermont	(1)	(1)					(1)	(1)					(1)	(1)			(1)	(1)
Virginia	20,413	170,041	14,316	133,465	11,098	79,314	16,580	116,513	(1)	(1)	9,604	72,619	(1)	(1)			181,282	1,365,931
Washington			(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)			(1)	(1)
West Virginia	31,551	209,163	6,021	46,039	191,918	1,378,136	(1)	(1)	(1)	(1)	15,002	115,727	(1)	(1)	(1)	(1)	409,952	3,103,183
Wisconsin	5,142	32,702	27,300	261,567	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	10,209	197,792			74,686	760,432
Undistributed [1]	99,635	814,840	102,638	1,165,827	196,918	1,645,114	273,834	2,262,815	41,490	342,304	121,669	1,032,509	930,241	7,802,653	426,549	3,937,011	764,367	6,917,663
	384,658	3,151,613	845,604	8,626,698	1,143,944	8,526,314	565,839	4,489,033	80,182	649,290	431,772	3,565,522	1,462,718	11,922,340	1,077,983	10,101,707	5,992,700	51,032,517

[1] Figures that may not be shown separately are combined as "Undistributed."

Lime (quick and hydrated) sold by producers in the United States, 1945–46, by uses

Use	1945			1946		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Agricultural	373,410	$2,906,844	$7.78	384,658	$3,151,613	$8.19
Building:						
Finishing lime	229,034	2,131,458	9.31	347,237	3,535,208	10.18
Mason's lime	241,802	2,111,177	8.73	389,003	3,996,480	10.27
Prepared masonry mortars	27,693	193,274	6.98	45,631	352,950	7.73
Unspecified	51,018	473,455	9.28	63,733	742,060	11.64
	549,547	4,909,364	8.93	845,604	8,626,698	10.20
Chemical and industrial:						
Alkalies (ammonium, potassium, and sodium compounds)	(1)	(1)	(1)	2,572	21,528	8.37
Asphalts and other bitumens				(1)	(1)	(1)
Bleach, liquid and powder [2]	24,712	192,041	7.77	13,872	124,239	8.96
Brick, sand-lime and slag	12,641	108,974	8.62	18,667	164,049	8.79
Brick, silica (refractory)	15,332	139,105	9.07	14,665	133,153	9.08
Calcium carbide and cyanamide	364,944	2,534,625	6.95	377,694	2,806,965	7.43
Chromates and bichromates	36,252	239,812	6.62	28,378	201,700	7.11
Coke and gas (gas purification and plant byproducts)	31,173	221,576	7.11	25,675	198,976	7.75
Explosives	15,531	124,933	8.04	1,579	14,399	9.12
Food products:						
Creameries and dairies	7,298	69,792	9.56	3,232	37,546	11.62
Gelatin	5,027	38,091	7.58	5,270	44,186	8.38
Stock feed	10,798	109,718	10.16	8,503	114,564	13.47
Other [3]	4,584	43,774	9.55	9,333	90,992	9.75
Glassworks	220,853	1,631,019	7.39	248,693	1,949,215	7.84
Glue	9,148	70,114	7.66	8,179	67,786	8.29
Grease, lubricating	2,068	15,282	7.39	2,722	22,346	8.21
Insecticides, fungicides, and disinfectants	82,507	713,465	8.65	96,457	888,114	9.21
Magnesia (85 percent)	23,647	210,544	8.90	26,376	246,495	9.35
Medicines and drugs	7,897	53,560	6.78	10,517	77,345	7.35
Metallurgy:						
Nonferrous smelter flux	7,442	59,695	8.02	9,560	76,030	7.95
Steel (open-hearth and electric furnace flux)	1,064,005	7,136,870	6.71	874,243	6,390,713	7.31
Ore concentration [4]	342,742	2,316,172	6.76	205,541	1,585,993	7.72
Wire drawing	16,645	147,508	8.86	13,527	125,111	9.25
Other [5]	11,868	94,879	7.99	41,073	348,467	8.48
Paints	18,950	136,215	7.19	25,598	239,113	9.34
Paper mills [2]	510,832	3,740,694	7.32	565,839	4,489,033	7.93
Petroleum refining	53,176	448,091	8.43	48,387	446,532	9.23
Rubber manufacture	7,170	51,133	7.13	3,193	26,516	8.30
Salt refining	1,884	13,103	6.95	4,384	32,067	7.31
Sewage and trade-wastes treatment	71,496	561,649	7.86	65,514	563,037	8.59
Soap and fat	5,221	33,246	6.37	2,897	20,572	7.10
Sugar refining	24,584	279,843	11.38	26,887	345,687	12.86
Tanneries	81,213	613,493	7.55	80,182	649,290	8.10
Varnish	364	3,460	9.51	302	3,766	12.47
Water purification	402,158	3,034,810	7.55	431,772	3,565,522	8.26
Wood distillation	1,265	11,624	9.19	3,830	29,660	7.74
Undistributed [6]	25,032	235,843	9.42	73,614	704,753	9.57
Unspecified	289,829	2,053,796	7.09	305,728	2,307,039	7.55
	3,810,288	27,488,549	7.21	3,684,455	29,152,499	7.91
Refractory lime (dead-burned dolomite)	1,187,334	10,613,711	8.94	1,077,983	10,101,707	9.37
Total lime [7]	5,920,579	45,918,468	7.76	5,992,700	51,032,517	8.52
Hydrated lime included in above distribution	1,355,028	11,422,254	8.43	1,648,369	15,083,399	9.15

[1] Included under "Undistributed."
[2] Bleach used in paper mills excluded from "Bleach" and included with "Paper mills."
[3] Includes chocolate, cocoa, fruit juices, phosphate baking powders, and unspecified food products.
[4] Includes flotation, cyanidation, bauxite purification, and magnesium manufacture.
[5] Includes mold coating and unspecified metallurgical uses.
[6] Includes acid neutralization, alcohol, calcium carbonate (precipitated), cement manufacture, polishing compounds, retarder, sulfur, textiles, and wool pullers; in addition, alkalies in 1945 and asphalts and other bitumens in 1946.
[7] Includes lime used by producers (captive tonnage) as follows—1945: 368,572 tons, valued at $2,216,373; 1946: 328,837 tons, $2,216,551.

Hydrated lime sold by producers in the United States, 1945–46, by uses

Use	1945			1946		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Agricultural	252,881	$2,078,924	$8.22	271,172	$2,251,936	$8.30
Building	434,026	3,762,343	8.67	639,549	6,275,938	9.81
Chemical and industrial:						
Bleach, liquid and powder	9,275	79,422	8.56	5,468	48,121	8.80
Brick, sand-lime and slag	(1)	(1)	(1)	3,270	31,395	9.60
Brick, silica	12,295	116,618	9.48	12,405	115,810	9.34
Coke and gas	1,819	14,362	7.90	1,124	9,888	8.80
Food products	13,889	138,138	9.95	15,215	157,333	10.34
Glass	2,834	23,473	8.28	(1)	(1)	(1)
Insecticides	60,233	538,828	8.95	72,910	687,638	9.43
Metallurgy	37,960	319,628	8.42	39,706	349,430	8.80
Paints	7,590	61,050	8.04	10,406	101,657	9.77
Paper mills	30,040	247,508	8.24	39,852	330,086	8.28
Petroleum	34,857	329,502	9.45	29,349	306,250	10.43
Sewage	29,241	242,681	8.30	33,157	287,798	8.68
Sugar	15,717	193,637	12.32	16,477	242,003	14.69
Tanneries	44,841	352,624	7.86	44,567	372,910	8.37
Water purification	181,350	1,497,703	8.26	226,939	2,021,579	8.91
Other uses	186,180	1,425,813	7.66	186,803	1,493,627	8.00
	668,121	5,580,987	8.35	737,648	6,555,525	8.89
Total hydrated lime	1,355,028	11,422,254	8.43	1,648,369	15,083,399	9.15

[1] Included under "Other uses."

Liming Materials Used in Agriculture.—Owing to the increase in agricultural activity in 1946, the market for agricultural liming materials was exceptionally active. Lime lost more ground to limestone ("agstone"), production of which increased 31 percent over 1945. The output of crushed oyster shells declined greatly, and that of marl increased appreciably compared with 1945 production.

Agricultural lime and other liming materials sold by producers in the United States, 1945–46, by kinds

Kind	1945				1946			
	Short tons		Value		Short tons		Value	
	Gross weight	Effective lime content [1]	Total	Average	Gross weight	Effective lime content [1]	Total	Average
Lime:								
Quicklime	120,529	102,450	$827,920	$6.87	113,486	96,460	$899,677	$7.93
Hydrated lime	252,881	177,020	2,078,924	8.22	271,172	189,820	2,251,936	8.30
Oystershells (crushed) [2]	138,032	64,880	572,399	4.15	60,691	28,530	357,119	5.88
Limestone	17,395,570	8,175,920	25,892,317	1.49	22,781,750	10,707,420	32,482,907	1.43
Calcareous marl	154,122	64,730	188,311	1.22	213,448	89,650	248,530	1.16
		[3]8,585,000	[3]29,559,871			11,111,880	36,240,169	

[1] Calculated upon basis of average percentages used by the National Lime Association, as follows: Quick lime (including lime from oystershells), 85 percent; hydrated lime, 70 percent; pulverized uncalcined limestone and oystershells, 47 percent; calcareous marl, 42 percent.
[2] Figures supplied by Fish and Wildlife Service.
[3] Revised figure.

Building Lime.—Building limes enjoyed the best year since 1941 and showed an increase of 54 percent over 1945 owing to increases in the types of construction requiring masonry mortars and finishing lime. In fact, the demand for finishing lime far exceeded the supply.

Chemical and Industrial Lime.—Sales in this class suffered from the reconversion of industry from war to peace but were nevertheless well-maintained in most categories. The metallurgical industries suffered from strikes and labor shortages, and sales of lime to these users dropped a little. The typically peacetime outlets, such as paper, water purification, insecticides, sand-lime brick, and paints, all showed increases. The greater tonnage of insecticides affected hydrated lime particularly. Further details are given in the accompanying table.

According to the National Lime Association, owing to the scarcity of gypsum in Sweden, it has proved economical to make high-quality dental and orthopedic gypsum by reacting lime with sulfuric acid wastes. The Association also reported that a large domestic paint manufacturer is formulating whitewashes containing lime and DDT. Preliminary tests under "synthetic dairy-barn" conditions appear promising, particularly with limes having a low content of heavy metals and silica.

APPARENT CONSUMPTION

Output exceeded apparent consumption in 16 of the 34 lime-producing States in 1946. Lime is a cheap commodity, widely available, and only a few States have large "export surpluses." In 1946 these States were Missouri, Ohio, Tennessee, and West Virginia.

Apparent consumption of lime in continental United States in 1946, by States, in short tons

State	Sales by producers	Shipments from State [1]	Shipments into State	Apparent consumption		
				Quicklime	Hydrated lime	Total
Alabama	294,654	94,848	58,498	237,730	20,574	258,304
Arizona	50,354	6,762	5,619	46,447	2,764	49,211
Arkansas	(2)	(2)	(2)	42,073	4,384	46,457
California	172,623	27,093	48,868	143,615	50,783	194,398
Colorado	(2)	(2)	(2)	25,140	7,284	32,424
Connecticut	(2)	(2)	(2)	17,438	13,425	30,863
Delaware			54,805	35,842	18,963	54,805
District of Columbia			11,676	252	11,424	11,676
Florida	(2)	(2)	(2)	41,321	35,782	77,103
Georgia	2,691	545	65,432	46,163	21,415	67,578
Idaho			4,516	2,640	1,876	4,516
Illinois	280,051	130,863	222,478	290,605	81,061	371,666
Indiana	(2)	(2)	(2)	144,885	38,129	183,014
Iowa			71,773	56,072	15,701	71,773
Kansas			30,985	13,549	17,436	30,985
Kentucky			155,415	139,282	16,133	155,415
Louisiana	(2)	(2)	(2)	92,279	22,567	114,846
Maine	(2)	(2)	(2)	66,056	8,190	74,246
Maryland	83,580	22,233	129,034	119,219	71,162	190,381
Massachusetts	117,709	65,778	31,094	48,834	34,191	83,025
Michigan	(2)	(2)	(2)	208,867	61,821	270,688
Minnesota	(2)	(2)	(2)	54,673	13,044	67,717
Mississippi			18,345	11,927	6,418	18,345
Missouri	799,742	556,015	33,646	153,882	123,491	277,373
Montana	(2)	(2)	(2)	15,653	3,144	18,797
Nebraska			10,113	1,636	8,477	10,113
Nevada	(2)	(2)	(2)	28,989	4,655	33,644
New Hampshire			12,543	9,020	3,523	12,543
New Jersey	(2)	(2)	(2)	57,891	125,728	183,619
New Mexico			24,291	1,011	23,280	24,291
New York	(2)	(2)	(2)	243,926	116,141	360,067
North Carolina			70,357	31,210	39,147	70,357
North Dakota			7,656	330	7,326	7,656
Ohio	1,469,278	982,038	254,220	592,587	148,873	741,460
Oklahoma	(2)	(2)	(2)	17,103	13,874	30,977
Oregon	(2)	(2)	(2)	35,175	3,890	39,065
Pennsylvania	972,311	483,537	439,335	708,097	220,012	928,109
Rhode Island			9,576	3,956	5,620	9,576
South Carolina			10,370	3,369	7,001	10,370
South Dakota	(2)	(2)	(2)	2,062	4,124	6,186
Tennessee	160,698	133,520	15,604	18,631	24,151	42,782
Texas	121,841	47,937	29,144	60,825	42,223	103,048
Utah	29,057	1,166	5,723	28,581	5,033	33,614
Vermont	(2)	(2)	(2)	619	1,234	1,853
Virginia	181,282	134,186	78,117	79,083	46,130	125,213
Washington	(2)	(2)	(2)	19,373	9,530	28,903
West Virginia	409,952	364,924	201,780	219,434	27,374	246,808
Wisconsin	74,686	21,385	73,312	95,069	31,544	126,613
Wyoming			2,054	403	1,651	2,054
Undistributed [2]	755,257	375,519	1,220,731			
	5,975,766	3,448,349	3,407,110	4,312,824	1,621,703	5,934,527

[1] Includes 41,239 tons exported or unclassified as to destination.
[2] Figures that may not be shown separately are combined as "Undistributed."

Apparent consumption of lime in continental United States in 1946, by region of origin and destination, in short tons

Destination	Origin														
	Illinois, Indiana, Michigan, Ohio			Maryland, New Jersey, New York, Pennsylvania, West Virginia			Connecticut, Maine, Massachusetts, Vermont			Florida, Georgia, Virginia			Alabama, Louisiana, Tennessee		
	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total
Illinois, Indiana, Michigan, Ohio	875,191	267,445	1,142,636	97,135	10,299	107,434	309	-------	309	23,556	445	24,001	565	3,018	3,583
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	368,214	124,253	492,467	885,492	419,622	1,305,114	21,442	30,095	51,537	78,677	10,320	88,997	6,749	1,400	8,149
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	2,108	11,924	14,032	66,850	8,885	75,735	76,576	45,161	121,737	270	70	340	-------	98	98
Florida, Georgia, North Carolina, South Carolina, Virginia	6,784	40,327	47,111	39,957	24,684	64,641	-------	100	100	36,586	42,370	78,956	104,903	41,135	146,038
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	79,357	21,735	101,092	2,033	1,571	3,604	-------	-------	-------	1,045	299	1,344	250,069	46,396	296,465
Arkansas, Kansas, Nebraska, Oklahoma, Texas	2,550	4,154	6,704	-------	-------	-------	-------	-------	-------	-------	-------	-------	119	-------	119
Iowa, Minnesota, Missouri, Wisconsin	60,741	34,812	95,553	-------	90	90	-------	-------	-------	-------	-------	-------	-------	890	890
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	5,940	10,816	16,756	-------	9,519	9,519	-------	-------	-------	-------	489	489	-------	100	100

Apparent consumption of lime in continental United States in 1946, by region of origin and destination, in short tons—Continued

Destination	Origin											
	Arkansas, Oklahoma, Texas			Minnesota, Missouri, Wisconsin			Arizona, California, Colorado, Montana, Nevada, Oregon, South Dakota, Utah, Washington			United States		
	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total	Quicklime	Hydrated lime	Total
Illinois, Indiana, Michigan, Ohio	820	730	1,550	239,348	47,947	287,295	20	-------	20	1,236,944	329,884	1,566,828
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	1,637	363	2,000	22,450	4,739	27,189	-------	12	12	1,384,661	590,804	1,975,465
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	-------	-------	-------	119	45	164	-------	-------	-------	145,923	66,183	212,106
Florida, Georgia, North Carolina, South Carolina, Virginia	975	-------	975	11,941	859	12,800	-------	-------	-------	201,146	149,475	350,621
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	52,238	9,827	62,065	115,107	10,015	125,122	-------	-------	-------	499,849	89,843	589,692
Arkansas, Kansas, Nebraska, Oklahoma, Texas	110,622	59,218	169,840	21,895	22,902	44,797	-------	120	120	135,186	86,394	221,580
Iowa, Minnesota, Missouri, Wisconsin	16,159	2,581	18,740	282,796	145,407	428,203	-------	-------	-------	359,696	183,780	543,476
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	11,402	6,498	17,900	7,445	13,722	21,167	324,632	84,196	408,828	349,419	125,340	474,759

Apparent consumption of hydrated lime from plants in Ohio and total continental United States in 1946, by region of destination

Destination	From Ohio plants			From all plants in continental United States	
	Short tons	Distribution (percent)	Percent of total shipments	Short tons	Distribution (percent)
Illinois, Indiana, Michigan, Ohio	235,728	52	71	329,884	20
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	117,118	26	20	590,804	36
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	11,924	2	18	66,183	4
Florida, Georgia, North Carolina, South Carolina, Virginia	40,222	9	27	149,475	9
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	17,413	4	19	89,843	6
Arkansas, Kansas, Nebraska, Oklahoma, Texas	3,734	1	4	86,394	5
Iowa, Minnesota, Missouri, Wisconsin	17,827	4	10	183,780	11
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	9,786	2	8	125,340	8
Undistributed and exports	519	(1)	5	11,472	1
	454,271	100	28	1,633,175	100

[1] Less than 1 percent.

As indicated in the accompanying table, small quantities of lime are shipped from continental United States to various island Territories.

Lime shipped to noncontiguous Territories of the United States, 1943–46

Territory	1943		1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Hawaii	1,170	$17,528	511	$8,197	246	$4,555	406	$8,373
Puerto Rico	4	170	415	5,572	1,458	20,144	365	5,276
Virgin Islands	103	3,462	121	3,876	80	2,100	142	3,160

PRICES

The net mill realization (excluding container cost) per ton of lime sold in the open market in 1946 averaged $8.52, a gain of $0.76 over 1945 and $1.00 over 1944. Numerous price increases were allowed by the Office of Price Administration before November 9, and industry-initiated increases were made thereafter. In 1946 the largest price increase was in building lime, whereas in 1944 and 1945 the largest increase was in agricultural lime.

FOREIGN TRADE [1]

Imports.—Lime imports are confined principally to movements from Canada to points in the State of Washington.

Lime imported for consumption in the United States, 1942–46

Year	Hydrated lime		Other lime		Dead-burned dolomite [1]		Total	
	Short tons [2]	Value	Short tons [2]	Value	Short tons	Value	Short tons	Value
1942	655	$6,722	7,445	$66,893	449	$11,260	8,549	$84,875
1943	740	6,670	13,911	119,358	739	22,563	15,390	148,591
1944	380	3,323	17,368	147,406	40	691	17,788	151,420
1945	677	6,501	20,108	172,676	73	33	20,858	179,210
1946	611	8,538	24,664	248,311	-------	-------	25,275	256,849

[1] "Dead-burned basic refractory material containing 6 percent or more of lime and consisting chiefly of magnesia and lime."
[2] Includes weight of immediate container.

Lime imported for consumption in the United States, 1944–46, by countries and customs districts [1]

Country of origin	Customs district of entry	1944		1945		1946	
		Short tons [2]	Value	Short tons [2]	Value	Short tons [2]	Value
Canada	Buffalo	80	$556	-------	-------	3,559	$27,187
	Connecticut	-------	-------	-------	-------	[3]	1
	Duluth and Superior	-------	-------	-------	-------	372	3,345
	Maine and New Hampshire	-------	-------	26	$352	71	1,122
	Michigan	-------	-------	1	6	-------	-------
	Oregon	52	434	40	334	-------	-------
	St. Lawrence	-------	-------	20	91	[3]	1
	San Francisco	-------	-------	1	26	-------	-------
	Vermont	-------	-------	-------	-------	122	1,337
	Washington	17,616	149,739	20,697	178,368	21,151	223,848
Dominican Republic	Puerto Rico	-------	-------	-------	-------	[3]	8
		17,748	150,729	20,785	179,177	25,275	256,849

[1] Exclusive of dead-burned basic refractory material.
[2] Includes weight of immediate container.
[3] Less than 1 ton.

Exports.—Exports of lime are small and confined almost exclusively to Canada and the Latin American countries.

Lime exported from the United States, 1942–46

Year	Short tons	Value	Year	Short tons	Value
1942	36,061	$400,845	1945	24,276	$268,875
1943	23,284	255,135	1946	33,540	423,948
1944	22,689	216,642			

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Lime exported from the United States, 1944–46, by countries

Country	1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value
Algeria					452	$1,434
Argentina	6	$321	6	$187	30	1,145
Bahamas	51	892	97	2,633	19	598
Belgium and Luxembourg					185	8,746
Brazil	68	1,471	22	1,196	39	1,095
Canada	7,507	35,816	8,379	48,721	11,430	91,320
Chile	54	1,346	6	371	3	518
Colombia	8	163	14	406	18	540
Costa Rica	1,473	18,235	38	415	4,117	48,173
Cuba	33	404	38	692	110	2,185
Curacao (N. W. I.)	22	440	50	677	75	1,299
Dominican Republic	114	1,081	20	188	25	251
El Salvador	83	1,673	49	1,179	76	1,847
Haiti	566	7,007	363	4,686	130	2,025
Honduras	7,811	84,320	6,017	69,758	6,700	75,483
Liberia	25	699	39	1,318	43	1,190
Mexico	2,010	28,969	4,587	73,734	5,008	82,233
Nicaragua	107	2,231	127	2,632	115	2,741
Panama, Republic of	2,586	26,177	3,715	38,955	3,713	48,265
Peru	74	1,221	278	4,299	126	2,498
Philippines, Republic of					89	1,638
Sweden			16	1,326	156	9,272
United Kingdom	38	1,854	170	8,342	733	34,197
Other countries	53	2,322	245	7,160	148	5,255
	22,689	216,642	24,276	268,875	33,540	423,948

TECHNOLOGIC DEVELOPMENTS

The old question of which is the better, the shaft or the rotary kiln, received further attention in 1946. W. R. Cliffe offered a paper adhering to the latter view before the annual convention of the Canadian Institute of Mining and Metallurgy on April 10, 1946, as opposed to the stand of V. J. Azbe, who had recommended shaft kilns at the previous annual meeting. A. B. Searle attempted to reconcile the two views.[2]

[2] Searle, A. B., Verticle and Rotary Lime Kilns—Which Are Best? Cement, Lime, and Gravel, vol. 21, No. 1, July 1946, pp. 6–15.

Magnesium

By C. E. NIGHMAN AND MARY E. TROUGHT

GENERAL SUMMARY

MAGNESIUM has not found in peace the utility it had in war. Domestic output rose from zero to 142 short tons in World War I (1918), then subsided into relative insignificance and did not reach that level again for a decade. In the following 10-year period the rate of growth was large, but the output had risen only to 3,350 tons in 1939. It grew then enormously to the 183,600-ton peak of World War II (1943). Magnesium shipments (exports excluded) of one-third million tons from January 1942 through June 1945, according to War Production Board figures, comprised 44 percent for production of aircraft, 34 percent for incendiaries, 12 percent for other military uses (principally tracer and incendiary ammunition), and the remaining 10 percent largely for aluminum alloys. Thus consumption was roughly half for structural purposes and half for destruction.

Salient statistics of the magnesium industry in the United States, 1942–46

	1942	1943	1944	1945	1946
Production of primary magnesium [1]—short tons	48,963	183,584	157,100	32,792	5,317
Quoted price per pound [2]—cents	22.5	20.5	20.5	20.5	20.5
Exports [3]—short tons	4,045	35,631	21,001	518	207
World production—do	115,800	263,000	232,700	54,500	13,200

[1] Ingot equivalent.
[2] Lowest nominal price (New York) for primary metal ingot, 99.8 percent pure, carlots.
[3] Magnesium metal, 1942 and 1946; metal and alloys, 1943–45.

In 1946, the first postwar year, domestic primary magnesium production was about one-sixth the 1945 output and less than one-thirtieth the wartime record. On the other hand consumption of primary metal and alloy was one-fifth of that in 1945 and is estimated to have been approximately five times the prewar average. Secondary recovery dropped 45 percent from 1945 but nearly equaled primary output in quantity. Estimated world production declined 76 percent from 1945 and was about 5 percent of the 1943 peak. The price of standard four-notch ingot remained at 20.5 cents a pound throughout the year.

PRODUCTION

Primary.—Compared with the various optimistic estimates that have been current, domestic production of primary metal in 1946 was highly disappointing. Output was only 16 percent of that in the preceding year and barely 3 percent of the wartime peak. It was,

however, about 60 percent above that of 1939, which was stimulated by war preparations.

A powerful depressant of primary production was the high secondary recovery, which receded only 45 percent from 1945 and in total nearly equaled virgin output. This ratio is extremely high—virtually double that of its companion light metal, aluminum—and probably would not exist normally. According to the Surplus Property Administration, at the end of 1945 the Office of Metals Reserve held about 25,000 tons of magnesium ingot. Under the terms of the Surplus Property Act this material was to be placed in permanent Government stocks. Another 25,000 tons in various forms was expected to be available from contract terminations and from several Federal agencies. In the light of the relatively small current requirements—shipments of castings and wrought products were 7,250 tons in 1946—the surplus constitutes a serious threat to the industry unless the orderly marketing recommended by the Surplus Property Administration is executed.

Since November 1945 the Dow Chemical Co. has been the only active producer. Its plant at Midland, Mich., was closed in the spring of 1946 and dismantled. Production is now concentrated at the Freeport, Tex., plant, which resumed operation in July. The Permanente Metals Corp. carried out experiments at its carbothermic reduction plant at Permanente, Calif., with a view to lowering operating costs, principally through conversion from batch to continuous distillation of the crude dust. At the year end the plant was not in commercial operation. With special permission of the Dow Chemical Co., the sole producer in 24 months, the accompanying table showing monthly domestic production of magnesium for the period 1941–46 has been made possible.

Disposal of Government-owned metal producing and fabricating facilities that had cost 400 million dollars progressed slowly in 1946. From the national security standpoint it had been estimated that capacity of 120,000 to 150,000 tons should be in condition to be operated if required. The six lowest-cost primary plants, with a

Production of primary magnesium (ingot equivalent), 1941–46, by months, in thousands of pounds [1]

Month	1941	1942	1943	1944	1945	1946
January	1,409	5,026	20,683	41,988	7,697	195
February	1,615	4,677	21,414	40,947	5,960	97
March	1,972	5,183	26,098	41,015	6,658	19
April	2,089	5,014	27,197	37,846	6,412	----------
May	2,476	5,271	30,269	34,308	6,407	----------
June	2,877	5,264	30,236	29,372	6,873	457
July	3,053	6,599	33,251	30,141	9,236	1,345
August	2,933	6,854	34,402	24,994	9,064	1,739
September	2,905	8,245	32,480	18,463	4,190	1,934
October	3,298	11,682	36,104	16,611	2,092	1,962
November	3,554	15,909	36,830	12,475	1,488	1,078
December	4,496	18,235	39,192	8,514	207	1,551
Total: Preliminary	32,677	97,959	[2] 368,156	[2] 336,674	66,284	10,377
Final	32,590	97,926	[2] 367,168	[2] 314,200	65,584	10,634

[1] Producers' reports to War Production Board, January 1941–August 1945, thereafter to Bureau of Mines. Monthly figures are preliminary and do not add to final totals derived from the Bureau's annual industry canvass.

[2] Excludes crystal equivalent of magnesium content of "goop"—919,000 pounds in 1943 and 12,945,000 pounds in 1944.

capacity of 97,000 tons, were so designated, and the other seven were to be disposed of for any purpose. In addition, there were 30,000 tons of privately owned plant capacity, of which, as noted heretofore, only 9,000 tons were in active operation at the year end. During the year the War Assets Administration offered for sale the plants of the first-named group. The Dow Chemical Co. acquired the Government-owned half (9,000 tons) of the Freeport, Tex., plant it had operated during the war and obtained a lease on the chemical portion of the 36,000-ton Velasco plant, contingent on maintenance of the

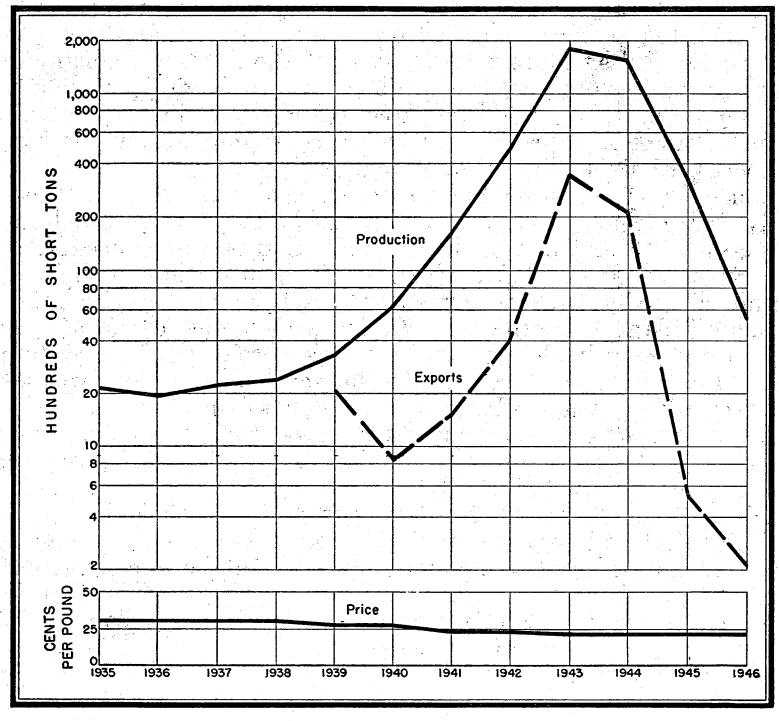

FIGURE 1.—Trends in production, exports, and quoted price of primary magnesium, 1935-46.

metal section. Of the Government-owned fabricating plants, only three were sold or leased for magnesium fabrication. Parts of others, and of metal plants as well, including the largest of all at Henderson, Nev. (56,000 tons), the plants at Marysville and Ludington, Mich. (36,000 tons), and the plant at Lake Charles, La. (27,000 tons), were leased or sold for a variety of purposes other than magnesium production.

Secondary.—Recovery of secondary magnesium, including alloying ingredients, totaled 5,117 short tons (including secondary magnesium incorporated in primary magnesium ingot) in 1946 (9,247 tons in 1945). This output was derived from 5,095 tons of magnesium scrap (76 percent of which was new) and from aluminum-base scrap. Of the quantity of magnesium recovered, 2,506 tons were as ingot; and 1,145 tons went into castings, 136 tons into magnesium-alloy shapes,

Production, sales, exports, and apparent consumption of primary magnesium in the United States, 1942–46, in short tons

	Production		Sales	Exports [1]	Apparent consumption [2]
	Raw, crude, and pure ingot	Ingot equivalent			
1942	[3]	48,963	47,420	4,045	43,375
1943	[4] 190,025	[4] 183,584	170,267	14,720	155,547
1944	[4] 161,935	[4] 157,100	146,585	4,830	141,755
1945	33,106	32,792	43,496	496	43,000
1946	5,317	5,317	8,916	207	8,709

[1] Primary metal only. Alloy exports in addition: 20,911 tons in 1943; 16,171 tons in 1944; 22 tons in 1945; and none in 1946; corresponding data for 1942 unavailable.
[2] Does not consider fluctuations in consumers' stocks and metal derived from scrap. Withdrawals from producers' stocks totaled 10,704 tons in 1945 and 3,599 in 1946. Additions to producers' stocks totaled 1,543 tons in 1942, 13,317 tons in 1943, and 10,515 tons in 1944.
[3] Not available.
[4] Does not include magnesium content of incendiary mixture produced direct.

1,218 tons into aluminum alloys, 6 tons into other alloys, and 106 tons into chemicals and incendiary products. Additional information on secondary magnesium will be found in this volume in the Secondary Metals—Nonferrous chapter.

CONSUMPTION AND USES

In comparison with estimates of postwar consumption that ranged from about 15,000 to 50,000 tons, the use of 9,873 tons of primary magnesium in 1946 was disappointing. Nevertheless it was more than three times the 1935–39 average production or sales rates (which were swollen by heavy export requirements) and consequently is indicative of an enhanced industrial acceptance.

The magnesium use pattern was tremendously altered in 1946. During the war the major use was for military purposes and almost

Actual domestic consumption of primary magnesium (ingot equivalent and magnesium content of magnesium-base alloys) in 1944–46, by uses, in short tons

Product	1944	1945 [1]	1946
Structural products:			
Castings:			
Sand	44,773	18,405	920
Die	1,165	803	341
Permanent mold	59,181	8,307	38
Sheet	1,543	1,517	1,990
Structural shapes, rods, tubing (extrusions)	4,784	2,452	2,689
Forgings	344	157	99
Total structural	111,790	31,641	6,077
Other products:			
Powder	9,080	4,769	192
Aluminum alloys	6,868	5,589	2,391
Other alloys	12	24	41
Scavenger and deoxidizer	159	228	248
Chemical	156	182	150
Other [2]	4,633	1,554	774
Total other products	20,908	12,346	3,796
Grand total	132,698	43,987	9,873

[1] Figures are incomplete owing to lack of returns from a number of wartime companies whose operations terminated during the year.
[2] Includes primary metal consumed in making secondary alloy.

exclusively so for about 3 years, with more than half the wartime output—of the United Kingdom as well as of the United States—going in incendiaries. Up to 1923 there was no important structural use for magnesium other than as a component of aluminum alloys. About 1927 foreign airplane makers began to apply it, but acceptance lagged in the United States; military agencies continued to be reluctant to employ it up to the outbreak of the war. It was estimated in 1940 that only 1.2 percent of the engines and about 1 percent of airframes and propellers were magnesium. In that year, 12,804 planes (6,019 of which were military, the remainder civilian) were constructed. The average airframe weight was 3,839 pounds, and about 80 pounds of magnesium was used per plane. In 1943, 85,898 planes (all military) with an average airframe weight of 7,621 pounds were built, and each contained about 1,100 pounds of magnesium; in the following year of peak plane output (96,318) the airframe weight had risen to nearly 10,000 pounds, and each contained about 1,000 pounds of magnesium. Although total plane output was large in 1946, the bulk was in small civilian planes that used little magnesium. Of the few military planes manufactured, many were relatively small, high-speed types, compared with the great number of heavy bombers [1] built during the war.

As a consequence of the loss of these major wartime outlets, primary magnesium consumption dropped 78 percent below that in 1945. Although affected by the increase in use of secondary metal, the drop in consumption was markedly in evidence in the quantity of virgin metal used for castings. This was only 5 percent of the 1945 use for these purposes and accounted for only 13 percent of total consumption in 1946, compared with nearly 63 percent in 1945. Powder output also showed the transition to peacetime uses, taking only 4 percent of that used in 1945 and was less than 2 percent of the total used in 1946. On the other hand, the use for wrought products rose in quantity, and relatively as well, indicative of new and wider ranges of application. They took 16 percent more new metal than in 1945 and comprised 48 percent of the total use compared with less than 9 percent in the preceding year. More secondary magnesium was consumed in aluminum-base alloy in 1946 than in 1945.

PRICES

The base price of virgin standard magnesium ingot remained throughout the year at 20.5 cents a pound, a price that has been in effect since January 1943. Prices of the principal casting alloys ranged from 23 to 25 cents, and extrusion billets from 26½ to 31 cents a pound, unchanged during the year. Secondary magnesium ingot (class A) was quoted by the American Metal Market at 15.75–16.25 cents a pound until October, when remelt ingot (without grade classification) was priced at 16–18 cents. In November it was listed at 17–18 cents and late in December at 18–18.50 cents a pound.

In Canada primary magnesium was priced at 23 cents a pound and in the United Kingdom at 1s.6d. to 2s.6d. a pound for metal during the first and at 1s.6d. to 2s.0d. in the second half year, or at the standard rate of exchange from 30 to 50 cents and 30 to 40 cents a

[1] In addition to the metal in the plane itself, the B–29 carried forty 500-pound bomb clusters.

pound, respectively. The French price was 66 francs a kilogram (25 cents a pound) for the first 5 months of 1946, 112 francs in June and July, 111 francs in August and September, and 116 francs (43.9 cents a pound) for the rest of the year. In 1945 the French price was equivalent to about 49.5 cents a pound.

FOREIGN TRADE [2]

Up to the First World War the United States had obtained its magnesium supplies from Germany. The development of a domestic metal industry in that period, with subsequent tariff protection, brought about virtual extinction of import trade. At least as early as 1928 there was an outward movement that was greatly accelerated during the 1930's as the continental nations began rearming, reaching a high point of about 2,100 tons in 1939. The outbreak of war slowed export, but it then leaped to 35,631 tons (including magnesium content of alloys) in 1943 and declined as precipitously to 1946, when at 207 tons it stood at the 1933 level. The accompanying table lists the principal foreign sales of the then sole producer, Dow Chemical Co., from 1928 to 1939, when the Department of Commerce began to report magnesium exports.

Major magnesium ingot and stick exports, 1928–39, in short tons [1]

Year	Belgium	France	Germany	Japan	Mexico	Netherlands	Poland	Sweden	U.S.S.R.	United Kingdom	Total
1928			2.5								2.5
1929		33.6	1.5							22.4	57.5
1930		11.1								30.3	41.4
1931										63.9	63.9
1932					30.0					55.4	85.4
1933			17.0		45.2				62.2	95.0	219.4
1934			1,179.7		90.3				28.1	124.9	1,423.0
1935			740.7		135.5					174.7	1,050.9
1936			56.2		186.0					188.2	430.4
1937					191.4					113.0	304.4
1938	3.2			762.5	170.9		11.0	5.6		244.0	[2]1,247.7
1939					160.6	224.2	179.4	13.4		1,644.4	2,222.0

[1] Dow and Magnesium, published by the Dow Chemical Co., Midland, Mich., 1944, 76 pp.
[2] Includes 50.5 tons for which distribution is not known.

In 1946 imports in all forms were 241 tons, an exceptionally high figure. Virtually all the material was reported as metal and scrap and came from Canada.

Exports of magnesium from the United States, 1945–46

Magnesium	1945		1946	
	Short tons	Value	Short tons	Value
Metal in primary form	[1] 518	$216,793	207	$85,382
Metal in other forms	140	292,430	87	48,892
Powder	720	579,736	12	6,104

[1] Includes 22 tons of magnesium-base alloy.

[2] Figures on imports and exports (unless otherwise stated) compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Exports of primary metal dropped 58 percent from 1945. Primary metal exports in 1946 were: 165 tons to Mexico, 17 to Canada, 15 to Switzerland, 7 to Argentina, 3 to Sweden, and a few hundred pounds each to three other countries. Ten tons of magnesium powder were shipped to Canada, and the remainder was distributed among seven countries. Of magnesium metal in other forms, Mexico received 51 tons, Venezuela 28, and 15 other countries the remainder.

TECHNOLOGIC DEVELOPMENTS

The war gave strong impetus to technical studies of magnesium now resulting in a voluminous literature [3] covering all phases from metal production from a wide range of raw materials to ultimate utilization. The manyfold disclosures suggest a strong upturn in magnesium's industrial uses in peace, in sharp contrast to its application in war as a powerful agent of destruction.

Although the lightest of commercially available metals and with virtually unlimited production possibilities, strong deterrents to its use have been its pronounced chemical reactivity, relatively weak physical characteristics, and high cost, particularly in cast- and wrought-product forms. Recent developments have tended to overcome many of the objections.

New melting and refining fluxes and improved operating procedures inhibit reactivity and provide metal freer of flux, gas, and contaminant inclusions. Highly purified magnesium has excellent noncorrosive qualities and with controlled alloy additions provides metal of improved strength characteristics. New alloys, notably with cerium and zirconium, bid fair to become important structural materials because of their enhanced physical properties, especially creep strength at elevated temperatures. On the mechanical side, continuous casting of billets is a material improvement over usual current practice. Hot chamber die casting, developed by a large German firm, offers much in cost reduction, possibly making products competitive with zinc. High-pressure forging methods, which were coming into

[3] Among the important publications, though with no pretense of coverage, may be mentioned the following:

Pidgeon, L. M., Mathes, J. D., Woldman, N. E., Winkler, J. V., and Loose, W. S., Magnesium: Am. Soc. for Metals, Cleveland, 1946, 265 pp.

Leontis, T. E., and Murphy, J. P., Properties of Cerium-Containing Magnesium Alloys at Room and Elevated Temperatures: Am. Inst. Min. and Met. Eng., Tech. Pub. 1995, Class E, Inst. of Metals Div., No. 501, 1946, 32 pp.

Doan, J. P., and Ansel G., Some Effects of Zirconium on Extrusion Properties of Magnesium-Base Alloys Containing Zinc: Am. Inst. Min. and Met. Eng., Tech. Pub. 2107, Class E, Metals Technol., December 1946, 18 pp.

Hanawalt, J. D., and Nelson, C. E., Corrosion Stability of Magnesium Alloys: Light Metals, vol. 8, No. 93, October 1945, pp. 492–505.

Eastwood, L. W., Fink, F. W., and Davis, James A., Relative Corrosion Resistance of Magnesium Alloys in Salt Water: Light Metal Age, April 1946, pp. 16–18, 42.

Ball, Major C. J. P., Outstanding Properties of Magnesium-Zirconium Alloys: Metallurgia, vol. 35, No. 207, January 1947, pp. 125–129; vol. 35, No. 208, February 1947, pp. 211–214.

Metal Industry, Magnesium Forgings, an Investigation into Their Production and Properties: Vol. 69, No. 1, July 5, 1946, pp. 8–11; vol. 69, No. 2, July 12, 1946, pp. 30–32.

Hanawalt, J. D., Industrial Significance of the Basic Characteristics of Magnesium: Metal Prog., vol. 49, No. 3, March 1946, pp. 548–552; vol. 49, No. 4, April 1946, pp. 739–743.

Fox, J. A., Magnesium and Its Alloys, a Survey of Recent Technical Progress: Metallurgia, vol. 35, No. 206, December 1946, pp. 85–91.

Gray, Allen G., a series of articles in Steel, as follows—Magnesium and Magnesium Alloys: Vol. 119, No. 17, Oct. 23, 1946, pp. 92–96, 112, 115–116. Casting Magnesium Alloys: Vol. 119, No. 19, Nov. 4, 1946, pp. 92–95, 130–132. Die Casting Magnesium Alloys: Vol. 119, No. 20, Nov. 11, 1946, pp. 150–152, 212. Heat Treating and Machining Magnesium Alloys: Vol. 120, No. 5, Feb. 3, 1947, pp. 102–106. Machining Magnesium Alloys: Vol. 120, No. 6, Feb. 10, 1947, pp. 101–102, 111–112. Riveting and Spotwelding Magnesium Alloys: Vol. 120, No. 9, Mar. 3, 1947, pp. 114–115, 142–154. Joining Magnesium Alloys: Vol. 120, No. 10, Mar. 10, 1947, pp. 90–91, 114–119. Forming Magnesium Alloys: Vol. 120, No. 16, Apr. 21, 1947, pp. 91, 126–133; vol. 120, No. 17, Apr. 28, 1947, pp. 105–106, 138–146. Organic Finishes for Magnesium Alloys: Vol. 120, No. 26, June 30, 1947, pp. 73–74, 101.

use in Germany, are being investigated; and, while a volume market does not yet exist, experiments on continuous rolling of sheet and strip indicate its feasibility.

From the cost standpoint, nothing comparable to the Dow seawater process has yet reached the production stage. Because of its common occurrence and high magnesium content olivine (essentially magnesium-iron silicate) has attracted much attention as a metal source. Wartime investigations of the Bureau of Mines [4] on production of magnesia or alternatively magnesium chloride from olivine by a hydrochloric acid digestion process present interesting possibilities. Not only may a high-quality product be made, but rough cost estimates were sufficiently favorable to warrant investigation on pilot-plant scale.

WORLD REVIEW

In 1946 estimated world output of 12,000 metric tons of primary magnesium dropped 76 percent from 1945 and was not as great as that of Germany a decade ago. In large part the prodigious decline resulted from the termination of war-engendered needs, accompanied by the exclusion of Germany and the Japanese Empire from the ranks of the producing nations. Although full data are not yet available, sufficient reports have been received to permit the revision of previous estimates as shown in the accompanying table.

Australia.—The 1,000-ton magnesium plant put into operation by Broken Hill Proprietary Co., Ltd., in 1941 ceased operation in 1944. Its production is shown in the subjoined table. Australian consump-

World production of magnesium, 1939–46, by countries, in metric tons

[Compiled by B. B. Mitchell]

Country	1939	1940	1941	1942	1943	1944	1945	1946
Australia	--------	--------	112	484	497	54	--------	--------
Canada	--------	--------	5	367	3,245	4,799	3,338	147
China:								
Formosa (Taiwan)	--------	--------	35	261	376	432	21	--------
Manchuria	--------	5	27	55	241	402	200	--------
France	3,917	2,562	1,989	1,334	1,542	703	277	707
Germany	[1] 14,000	17,720	24,000	30,000	32,400	33,600	[2] 4,225	--------
Italy	3	438	1,857	2,494	[1] 2,800	[1] 3,000	[1] 400	[1] 1,300
Japan	1,629	2,720	2,575	2,020	2,777	2,904	1,020	--------
Korea	49	260	263	240	532	1,628	1,014	--------
Norway [1]	--------	--------	100	2,000	2,000	2,000	500	500
Switzerland [1]	700	700	700	1,500	1,500	1,000	500	300
U. S. S. R. [1]	1,000	1,500	4,000	5,000	5,000	5,000	2,170	3,000
United Kingdom	[3] 5,080	[3] 6,200	9,380	14,865	19,096	13,094	6,000	1,200
United States	3,039	5,680	14,782	44,418	166,544	142,518	29,748	4,823
Total	29,417	37,785	59,825	105,038	238,550	211,134	49,413	11,977

[1] Estimated by authors.
[2] January-February only. Planned production for March, 2,830 tons.
[3] Includes scrap.

[4] Gee, E. A., McCarthy, Charles E., Riordan, Frank S., Jr., and Pawel, Morton T., Magnesia from Olivine: Bureau of Mines Rept. of Investigations 3938, 1946, 33 pp.
Other Bureau reports are—
Doerner, H. A. and Holbrook, W. F., Chlorination of Magnesia: Rept. of Investigations 3833, 1945, 25 pp.
Garst, O. C., Examination and Treatment of Industrial Magnesium Foundry Wastes: Rept. of Investigations 3860, 1946, 36 pp.
Michels, Lloyd R., Cartwright, Burke, and Ravitz, S. F., Reduction of Magnesium Chloride by Calcium Carbide: Rept. of Investigations 4059, 1947, 8 pp.
Doerner, H. A., Holbrook, W. F., and Fortner, Otis W., The Bicarbonate Process for the Production of Magnesium Oxide: Tech. Paper 684, 1946, 48 pp.
Lloyd, R. R., Stoddard, C. K., Mattingly, K. L., Leidigh, E. T., and Knickerbocker, R. G., Pilot-Plant Production of Electrolytic Magnesium from Magnesia: Am. Inst. Min. and Met. Eng., Tech. Pub. 1848, Class D, Nonferrous Metallurgy, No. 89, 1945, 25 pp.

tion of ingot and powder in metric tons was respectively as follows: 1942, 153 and 61; 1943, 266 and 60; 1944, 155 and 17; 1945, 62 and 12. The powder was imported from the United Kingdom, United States, and Canada.

Canada.—Production cut-back was relatively much greater than in the United States. Sales were largely from stocks. Shipments were made to Sweden, Belgium, Czechoslovakia, and Mexico. The Dominion Magnesium Co., Ltd., increased the casting facilities of its subsidiary, Light Alloys, Ltd., and was to resume operation at the Haley's Station, Ont., plant in January 1947, but principally for the production of calcium metal.

Germany.[5]—The first commercial production of magnesium began at Bitterfeld in 1896. Although there had been sporadic attempts at production in other countries both before and after that time, Germany was virtually the sole world supplier up to the First World War. Then magnesium production was expanded and structural alloys containing aluminum and zinc ("Elektron") that had been developed about 1909 found considerable application as substitutes for scarce copper and aluminum. These alloys commanded attention elsewhere, but as late as 1925 only the United States and France were its competitors. Although data are not fully available, Germany probably maintained production supremacy through the interwar period and until 1942, when surpassed by the United States.

At the outbreak of World War II production facilities were concentrated in central Germany. There was none in the annexed areas nor in Austria. Annual capacity of operating plants and other data are given in the following table:

Operator	Plant location	Occupation zone	Capacity (metric tons)	
			1938	1944 (Nov.)
I. G. Farbenindustrie, A. G	Aken	U. S. S. R	10,000	11,400
Do	Bitterfeld	do	3,900	3,900
Do	Stassfurt [1]	do	4,000	12,500
Do	Bitterfeld [2]	do	60	1,000
Wintershall, A. G	Heringen	U. S	1,000	6,800

[1] Expanded to 12,000 tons capacity in 1942.
[2] Originally an experimental ferrosilicon reduction plant. Output probably did not exceed 1,000 tons annually during the war.

In contrast to the aluminum industry that depended on foreign ores and suffered severely from mounting transport difficulties as the war progressed, magnesium production using local raw materials was not heampred. The I. G. Farbenindustrie plants generally used waste magnesium chloride from potash plants in the vicinity with dolomite from the Harz Mountains and the Nurnberg district. The Wintershall company employed carnallite (potassium-magnesium chloride) from its nearby potash mine.

According to the German census for 1936, crude magnesium production was 13,311 metric tons (12,800 tons magnesium content),

[5] Most of the data have been derived from Economic Survey of Germany, The Metal Industries, prepared by the Economic Advisory Branch, Foreign Office and Ministry of Economic Warfare, London, September 1944; from German Aluminum and Magnesium Industries, Field Information Agency, Technical Final Report No. 501, Office of Military Government for Germany (U. S.), November 1945; and Metallurgical and Industrial Developments in Magnesium, FIAT Final Report 89, Joint Intelligence Objectives Agency.

and consumption was 12,742 tons. Scrap recovery was about 900 tons. Primary production in 1937 was estimated to be 12,000 tons and was reported at 13,200 tons in 1938 with 1,800 tons of secondary metal. The accompanying table compiled from various sources gives production and other data for the war period.

Salient statistics of magnesium in Germany, 1939–45, in metric tons

	1939	1940	1941	1942	1943	1944	1945
Primary production	[1] 14,000	17,720	24,000	30,000	32,400	33,600	[2] 4,225
Total production [3]	(4)	(4)	25,080	33,420	43,368	[5] 45,660	(4)
Imports: [6]							
Occupied countries		60	2,400	1,800	912	(4)	(4)
Others			180	960	840	(4)	(4)
Consumption [7]	[8] 13,000	15,900	27,800	32,700	44,600	39,370	(4)
Stocks end of year	4,985	6,485	6,365	9,845	10,565	12,855	(4)

[1] Estimated. Last 4 months 5,060 tons.
[2] January–February only. Planned production, March, 2,830 tons.
[3] Includes waste and scrap added to virgin metal for production of usable lower-grade alloys.
[4] Figure not available.
[5] Includes imports given as 1,500 tons in original report.
[6] Distribution by years and sources unlike in different reports but period totals in fairly close agreement.
[7] Includes virgin and secondary, alloyed and unalloyed metal.
[8] Estimated. Last 4 months, 4,500 tons.

Before the war it was estimated that 30 percent of the metal output was used for military purposes, 35 percent went to civilian use, and 35 percent was exported. During the war, distribution was controlled by the Air Ministry, which took about 90 percent for the air force, army, and navy; 2 to 3 percent was for export, and the remainder for civilian uses was largely for military needs. About one-half the military consumption was in explosives and incendiaries. Wartime requirements appear to have been underestimated. Civilian consumption was first restricted only a few days before the invasion of Poland on September 1, 1939. Shortly thereafter zinc die castings replaced magnesium in portable wireless sets and other military equipment; later aluminum displaced magnesium, especially in field-artillery uses, and by 1944 both were being supplanted by steel and wood in airplanes. Because of the shortage, domestic production was stimulated largely by increasing secondary recovery, and accomplished in part by increasing impurity tolerances, notably in silicon and copper, and by enlargement of domestic plant capacity, which was limited principally by inadequate power supply. Unsuccessful attempts were made to develop production outside Germany proper. In 1943 a seawater plant was completed at Heren, Norway, but was bombed the day it began operation; another at Diosgyr near Miskolc, Hungary, did not get into production; construction of a 12,000-ton plant at Mossbierbaum, about 40 miles west of Vienna, was undertaken but did not progress beyond the building-construction stage.

There were more than 20 fabricating plants. Of these the I. G. Farbenindustrie A. G. and three associated companies' works were the largest makers of castings (other than die), extrusions, and rolled products. All are in the Russian zone. The largest die caster was the Mahle K. G. and subsidiaries (largely in the American zone). This company was the pioneer in pressure die casting in Germany and developed the hot-chamber method and equipment. This is be-

lieved to be superior to the cold-chamber, higher-pressure method used elsewhere in Germany and other countries. The Wintershall company, a primary producer, also converted part of its output to forgings, castings, and extrusions. According to this company, in 1943–44, 60 percent of German magnesium consumption was for castings, and the remainder appeared as mill products. Other sources of information give as much as 75 percent for castings and 25 percent for wrought products including 8 percent for pyrotechnics.

During the war the use of magnesium for structural purposes was nearly confined to airplanes. Among the many parts were engine mounts, crankcases for radial air-cooled and liquid-cooled engines, bomb-bay doors, landing-gear struts and wheels, wing tips and engine cowling, and large cooling fans. Jet-engine housings and rotor and stator rings of turbocompressors were also fabricated from magnesium alloys. Although magnesium propellers had been used for commercial planes, they were not used for military planes because they were more easily bullet-shattered than aluminum alloy. Parts of the V–2 bombs were made of magnesium, as were large rocket shells. Automotive uses were virtually discontinued during the war. Before the war oil pumps were in quantity production, and it was planned to make many other parts such as crank cases, rear axle parts, and transmission cases therefrom. A successful application was in cast field-artillery wheels up to 5 feet in diameter. Magnesium foundry flasks were much used.

In the main, German wartime practices followed those described by Dr. Adolf Beck, of the I. G. Farben. organization, in his work "Magnesium und seine Legierungen," published in 1939.[6] They diverge from British and American practices in numerous respects and in some were superior or were claimed to be better than those in other countries. Among the latter were the increasing use of continuous-billet casting, hot-chamber die casting, and the use of 30,000- and 15,000-ton hydraulic presses for forging large structural elements, such as gun carriages. Anhydrous ferric chloride ($FeCl_3$) was employed for refining ("Elfinal" process) cast metal. Less superheat is required and removal of hydrogen and iron is improved. In general, the Germans had not recognized until late in the war the importance of high-purity magnesium as the base for alloying. Most of the materials used had much higher contaminant tolerances than customary in the United States or in England. On the other hand I. G. Farben. investigated and patented many magnesium-base alloys, some of which contained as many as six components. Among them, cerium and zirconium gave highly promising results. Cerium (added as Mischmetall) gave some grain refinement, reduction in microporosity, and higher creep resistance at elevated temperatures than other known alloys. Practical use of a nominal 6-percent cerium alloy was carried on for about a year in the supercharger impellers and rear cam-follower guides of the BMW–801 airplane engines, but production was discontinued because of the shortage in cerium. Zirconium alloys were also described by Beck, and some attempts were made to bring them to a production stage with most of the work on casting alloys. Results appear to have been only partly satisfactory. The

[6] An English translation by the staff of F. A. Hughes & Co., Ltd., and Magnesium Elektron, Ltd., originally an I. G. Farben associate, entitled The Technology of Magnesium and its Alloys, was published by the first named company in London, 1940.

pronounced grain-refining effect with increased strength and ductility given by zirconium additions indicate a wider field of application of magnesium-base alloys.

Japan.—Production of magnesium is said to have begun as early as 1919 but the earliest available records of production commence with 1931.[7] Although several companies were experimenting with production from various raw materials, the Riken Kinzoku Co., Ltd., an amalgamation of other companies, was the sole commercial producer from 1933 through 1936. Its output was in those years, respectively, 33, 142, 234, and 578 metric tons. It remained the principal supplier until 1942 and furnished about 45 percent of the total Home Islands output in 1933–45. There were three producers in 1937, which grew to eight in 1941. One then ceased production, with a second closed in 1943, leaving six in operation in 1945. In addition, beginning in 1938, six plants were in operation in Korea in 1945; one was in production in Formosa, 1941–45; and there were two in Manchuria, with a third large plant completed in July 1945. The peak rated capacity in Japan proper was 6,950 tons and in Korea 7,700 tons, but at the end of the war the former had dropped to 2,340 tons.

Plants that furnished about one-half the Home Islands metal for the most part used, as raw material, brines or byproduct bitterns resulting from extraction of salt from sea water, as did three of the Korean plants. The shortage of salt and of imported raw material in 1941 led the largest maker—the Riken company—to experiment with production from sea water. In 1944 about 25 percent of its product was so derived. Japan also lacked magnesite, and nearly half the industry used magnesia or magnesite imported from Korea or Manchuria. Part of the plants in those countries and in Formosa used the same basic materials. These plants employed the I. G. Farbenindustrie method of preparing electrolytic-cell feed. The Nippon Magnesium Co., Ltd. (later the Mittetsu Magnesium Co., Ltd.), employed the Hansgirg or carbothermic reduction method at the Konan, Korea, plant throughout its operation. The maximum output (1944) was about 1.5 tons daily. Data on consumption are not available, but it was estimated that aircraft took about 90 percent of the output in 1942–45.

United Kingdom.—Only since 1935 has the United Kingdom been a commercial producer of magnesium. In that year, Magnesium Electron, Ltd., constructed an electrolytic plant near Manchester, but the country remained largely dependent on metal imports. During the war the Government expended £6,100,000 for the erection of three other plants in the United Kingdom. The Minister of Supply reported that demand reached 100,000 tons a year during that period, but domestic plants turned out only 19,000 tons at the peak. Recorded exports from the United States were about 16,000 tons, while Canada furnished a few thousand tons. The total supply fell far below the estimated demand, but demand fell sharply after 1943 and again markedly at the end of the war, until in mid-1946 it was estimated to be less than 2,500 tons, most of which could be obtained from scrap.

[7] Minerals Yearbook, 1937, p. 729, states "Japanese magnesium production was 3,219 kilograms in 1931 24,018 in 1932, 104,812 in 1933, and 140,808 in 1934. All official data terminated after 1934 * * * ."

Magnesium Compounds and Miscellaneous Salines

By CHARLES L. HARNESS AND F. M. BARSIGIAN[1]

	PAGE
General summary	736
Part I.—Magnesium compounds	736
Magnesite	736
Salient statistics	737
Prices	739
Review by States	739
Foreign countries	740
Dolomite	741
Other magnesium compounds	741
Part II.—Miscellaneous salines	743
Calcium chloride	743
Bromine	744
Iodine	745
Sodium compounds	746
Borates	749

GENERAL SUMMARY

MAGNESITE production declined further in 1946, amounting to 4 percent less than in 1945 and less than half the all-time peak of over 750,000 tons in the war year 1943. The drop from 1945 was caused mostly by smaller requirements of the steel industry for basic refractories. Caustic-calcined magnesias, on the other hand, showed a perceptible increase in sales, reflecting sustained markets in the fertilizer, oxychloride cement, rayon, rubber, and other industries. Calcium chloride, used in stabilizing dirt roads, set a new record. Bromine output fell drastically, owing to the peacetime drop in gasoline-antiknock sales. Iodine shipments were higher. The world shortage of soda ash gave natural sodium carbonate the best year in its history, and sodium sulfate sales also set a record in 1946. As export markets gradually reopened during the year, shipments of borates mounted to unprecedented heights, and production surpassed even the previous record year, 1937.

PART I.—MAGNESIUM COMPOUNDS

MAGNESITE

Output of crude magnesite was unusually high for a peacetime year—324,640 short tons, almost double the 1937–39 average of 166,000 tons. Production was only a little below that of the last war year, 1945. But for the steel and coal strikes in 1946, requirements for basic

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

refractories might have driven crude magnesite production even higher than in 1945. Fortunately the major users of magnesite had virtually no reconversion problems; and demand for magnesias of various grades, both refractory and caustic-calcined, was affected comparatively little by the change-over to a peacetime economy.

Salient statistics of the magnesite industry in the United States, 1942–46

	1942	1943	1944	1945	1946
Crude magnesite:					
Mined:					
Short tons	[1] 497,368	754,832	561,450	336,458	324,640
Value [1]	$3,874,334	$6,071,596	$4,407,461	$2,324,957	$2,225,850
Sold by producers:					
Short tons	6,835	4,090	(2)	(2)	(2)
Value	$57,350	$47,788	(2)	(2)	(2)
Average per ton [3]	$8.39	$11.68	(2)	(2)	(2)
Imports for consumption:					
Short tons			1,039		1
Value			$34,588		$56
Caustic-calcined magnesia:					
Sold or used by producers: [4]					
Short tons	41,889	191,792	139,243	43,270	45,178
Value	$2,028,126	$11,497,505	$6,481,963	$2,503,544	$2,854,538
Average per ton [3]	$48.42	$59.95	$46.55	$57.86	$63.18
Imports for consumption:					
Short tons	578	290	559	445	441
Value	$19,105	$13,122	$15,286	$12,134	$12,985
Refractory magnesia:					
Sold or used by producers: [5]					
Short tons	273,661	301,382	278,490	254,994	244,824
Value	$7,823,963	$9,341,183	$8,426,049	$7,414,218	$7,231,869
Average per ton [3]	$28.59	$30.99	$30.26	$29.08	$29.54
Imports for consumption:					
Short tons	7,728	9,233	6,176	5,506	1,873
Value	$280,342	$310,497	$260,062	$234,519	$182,574

[1] Partly estimated; most of the crude is processed by the mining companies, and very little enters open market.
[2] Bureau of Mines not at liberty to publish figures.
[3] Average receipts f. o. b. mine shipping point.
[4] Includes caustic-calcined magnesite and reactive magnesia from sea-water bitterns, well brines, and raw sea water and from precipitated magnesium carbonate obtained from dolomite.
[5] Includes dead-burned magnesite and refractory magnesia from brucite, dolomite, sea-water bitterns, well brines, and raw sea water; there was none from well brines in 1944.

Magnesia sold or used by producers in the United States, 1945–46, by kinds and sources

Magnesia	From magnesite, brucite, and dolomite		From well brines, raw sea water, and sea-water bitterns		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1945						
Caustic-calcined	16,098	$1,122,119	27,172	$1,381,425	43,270	$2,503,544
Refractory	193,693	5,068,987	61,301	2,345,231	254,994	7,414,218
	209,791	6,191,106	88,473	3,726,656	298,264	9,917,762
1946						
Caustic-calcined	16,269	1,310,584	28,909	1,543,954	45,178	2,854,538
Refractory	174,121	4,539,978	70,703	2,691,891	244,824	7,231,869
	190,390	5,850,562	99,612	4,235,845	290,002	10,086,407

Magnesite imported for consumption in the United States, 1944–46, by countries

Country	1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value
CRUDE MAGNESITE						
Cuba	47	$857				
Malta, Gozo, and Cyprus					(1)	$6
Mexico					1	50
U. S. S. R.	992	33,731				
	1,039	34,588			1	56
LUMP CAUSTIC-CALCINED MAGNESITE						
Canada	3	$82	(1)	$9		
India and Dependencies	551	14,748	443	11,820	429	$11,318
United Kingdom	5	456				
	559	15,286	443	11,829	429	11,318
GROUND CAUSTIC-CALCINED MAGNESITE						
Netherlands					5	$475
United Kingdom			2	$305	7	1,192
			2	305	12	1,667
DEAD-BURNED AND GRAIN MAGNESITE AND PERICLASE						
Australia			33	$1,024		
Canada	780	$76,263	746	72,788	1,873	$182,574
U. S. S. R.	5,396	183,799	4,727	160,707		
	6,176	260,062	5,506	234,519	1,873	182,574

[1] Less than 1 ton.

The disagreement over the relative merits of the rammed basic open-hearth steel furnace and the burned-in magnesite hearth continued unabated in 1946, with articulate adherents to both points of view.[2] During the past several years, when furnaces have been rebuilt the tendency has been to ram in the bottom rather than burn it in. The trend has induced makers of magnesia refractories to modify the composition of their grain magnesia for ramming use. The quantity of basic refractories used per ton of ingot steel increased considerably during the war years, but whether this was due to the advent of the rammed hearth or to the sacrifice of the furnace to speed is difficult to determine.

The Bureau of Mines developed a laboratory method for obtaining magnesium oxide from olivine by means of hydrochloric acid digestion.[3]

[2] Snow, R. B., Behavior of Various Types of Open-Hearth Bottoms in Service: Proc., 29th Conf., National Open Hearth Committee, Iron and Steel Division, vol. 29, 1946, pp. 87–92.
McCarthy, B. D., Comparison of Fully Rammed Bottoms, Partly Rammed Bottoms with Burned-in Top Surface, and Fully Burned-in Bottoms: Pp. 93–98.
Schwartz, E. H., Experience with Sintered and Rammed Bottoms at Wisconsin Steel Works: Pp. 98–102.

[3] Gee, E. A., McCarthy, C. E., Riodan, F. S., Jr., Pawel, M. T., Magnesia from Olivine: Bureau of Mines Rept. of Investigations 3938, 1946, 33 pp.

A symposium on magnesian fertilizers was held at the September 1946 meeting of the American Chemical Society in Chicago; 10 papers were given.[4]

Gas-oxygen firing of open-hearth furnaces may or may not call for greater consumption of basic refractories.[5]

PRICES

The Office of Price Administration released dead-burned magnesite from price control July 19, 1946, and all other grades were decontrolled by OPA Supplementary Order 193 of November 12, effective November 10. According to E&MJ Metal and Mineral Markets, the price of maintenance-grade dead-burned magnesite remained at $22 during the year. The Westvaco Chlorine Products Corp. offered the following price schedule for its magnesias (carlots, f. o. b. California): Caustic-calcined magnesite, bulk—$61.50, powdered—$67.50; calcined (sea-water) magnesia, bulk—$54, powdered—$60; sea-water periclase, bulk, 85 percent—$39.50, 90 percent—$40 a short ton.

REVIEW BY STATES

California.—Johns-Manville Corp., 22 East Fortieth Street, New York 16, N. Y., recovered purified magnesium carbonate from magnesite at Redwood City for use in 85-percent magnesia insulation. Marine Magnesium Products Corp., South San Francisco, continued its output of specialty magnesias, using as raw materials lime, dolomite, and the waters of San Francisco Bay. The firm completed a plant to make magnesia from dolomite by a patented variation of the Pattinson process. The product has a purity of 99.5 percent, whereas sea-water magnesia rarely analyzes higher than 97.5 to 98 percent. The Permanente Metals Corp., Permanente, Calif., operated its magnesia-from-sea-water plant at Moss Landing, making refractory and caustic-calcined magnesias. Plant Rubber & Asbestos Works, 537 Brannan St., San Francisco, Calif., made 85-percent magnesia at its Emeryville and Redwood City plants. Westvaco Chlorine Products Corp., Newark, Calif., recovered, by hand selection, magnesite from its Western mine near Livermore and produced refractory and caustic grades of magnesia at Newark from sea-water bitterns. The firm also recovered magnesium chloride from sea-water bitterns at Chula Vista.

Georgia.—International Minerals & Chemical Corp., 20 North Wacker Drive, Chicago 6, Ill., produced epsom salt from serpentine and sulfuric acid at its Augusta plant but reported that the plant would not operate in 1947.

Illinois.—At its Waukegan plant the Johns-Manville Corp., 22 East Fortieth Street, New York 16, N. Y., produced precipitated magnesium carbonate by the Pattinson process for use in 85-percent magnesia insulation.

Michigan.—The Dow Chemical Co., Midland, Mich., continued its production of magnesium chloride and sulfate from well brines and dolomite. Michigan Chemical Corp., St. Louis, Mich., recovered

[4] Titles listed in Chemical and Engineering News, vol. 24, No. 15, Aug. 10, 1946, p. 2057. Abstracts published by the American Chemical Society, Washington, D. C.
[5] Steel, vol. 119, No. 11, Sept. 8, 1946, p. 140.

magnesia from dolomite and well brines. Morton Salt Co., 310 South Michigan Ave., Chicago 4, Ill., produced precipitated magnesium carbonate from lime and well brines at its Manistee plant. The synthetic magnesia produced by the Standard Lime & Stone Co. from Manistee well brines was described.[6] Waste brines are treated with dolomitic milk of lime, and the resultant precipitate of magnesium hydroxide is filtered and dried. Sufficient iron oxide, silica, and other "impurities" are deliberately added to give a finished analysis of magnesia 84.0, ferric oxide 5.5, silica 4.5, alumina 2.0, and lime 4.0 percent. The magnesia product is used in lining basic open-hearth steel furnaces.

Nevada.—Basic Refractories, Inc., mined brucite at Gabbs and shipped it to Narlo, Ohio, for calcining and manufacture into basic open-hearth dressings and ramming mixes. Sierra Magnesite Co., Newark, Calif., an affiliate of Westvaco Chlorine Products Corp. and Henry J. Kaiser and associates, continued to mine magnesite at Gabbs, all for "caustic-calcined" uses.

New Jersey.—Johns-Manville Corp., 22 East Fortieth Street, New York 16, N. Y., produced precipitated magnesium carbonate by the Pattinson process for use in 85-percent magnesia insulation at its Manville plant. Northwest Magnesite Co., 1800 Farmers Bank Building Pittsburgh 22, Pa., recovered refractory magnesia from raw sea water at its Cape May plant.

Pennsylvania.—Three firms in the Philadelphia area used the Pattinson process in making magnesium carbonate for 85-percent magnesia insulation and other purposes—the Philip Carey Manufacturing Co., 1935 Easton Boulevard, Lockland, Cincinnati 15, Ohio, plant at Plymouth Meeting, Pa., Ehret Magnesia Manufacturing Co., Valley Forge; and Keasbey and Mattison Co., Butler Avenue and Maple Street, Ambler. General Magnesite and Magnesia Corp., 705 Architects Bldg., Philadelphia 3, Pa., made magnesium oxide from purchased magnesium carbonate. The process used by this firm has been described.[7]

Texas.—Dow Chemical Corp., Freeport, recovered magnesium chloride and oxide from sea water, the former for reduction to metal and the latter for fertilizer. Gardner & Cates, Llano, made caustic-calcined magnesite for the fertilizer market.

Washington.—Northwest Magnesite Co., 1800 Farmers Bank Building, Pittsburgh, Pa., was the sole producer of refractory magnesite in 1946, as in 1945. This operation is by far the largest magnesite producer in the country.

West Virginia.—The Standard Lime & Stone Co. continued its recovery of refractory magnesia by leaching calcined dolomite at its Millville plant. Magnesium carbonate is also produced from dolomite by the Pattinson process at this location.

FOREIGN COUNTRIES

Information on magnesite in the principal foreign producing countries, including Austria, Manchuria, Czechoslovakia, Greece, and Soviet Russia, has been meager for a number of years. However,

[6] Iron Age, vol. 157, No. 18, May 2, 1946, p. 70.
[7] Smith, A. Q., Complex Processing Used for Light Magnesium Oxide: Chem. Eng., vol. 53, No. 10, October 1946, p. 119.

statistics in the following paragraphs throw some light on the European and Australian industries.

Australia.—Production during the period 1939–45 was reported as follows: 1939, 26,094 metric tons; 1940, 25,287 tons; 1941, 28,144 tons; 1942, 35,501 tons; 1943, 65,901 tons; 1944, 32,213 tons; and 1945, 23,453 tons.

Austria.—Production of magnesite in Austria has been relatively low since the end of hositilities. Output has been reported as: 1942, 482,397 metric tons; 1943, 494,428 tons; 1944, 480,564 tons; 1945, 94,948 tons; and 1946, 95,388 tons.

Greece.—As compared with prewar levels, output in recent years has been small. Production was reported as follows, in metric tons: 1943, 680; 1944, 950; 1945, 1,650; and 1946, 4,500.

DOLOMITE

The steel strike in 1946, with the subsequent furnace shut-down, adversely affected sales of dead-burned dolomite, and total shipments during the year were 9 percent lower than in 1945. There were no imports in 1946.

Dead-burned dolomite sold in and imported into the United States, 1942–46

Year	Sales		Imports [1]		Year	Sales		Imports [1]	
	Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
1942	1,229,357	$10,817,634	449	$11,260	1945	1,187,334	$10,613,711	73	$33
1943	1,276,725	11,243,017	739	22,563	1946	1,077,983	10,101,707	-------	-------
1944	1,290,790	11,441,612	40	691					

[1] Reported as "Dead-burned basic refractory material."

A paper on the recovery of magnesia from dolomite on a pilot-plant scale was given at the annual meeting of the American Institute of Mining and Metallurgical Engineers in New York, March 1947.[8] Owing to the ready availability of dolomite in regions of greatest steel production, the process may offer attractive freight savings if developed on a commercial scale.

Additional information on dolomite is contained in the Stone chapter of this volume.

OTHER MAGNESIUM COMPOUNDS

Production of high-cost magnesias (as distinguished from the low-cost refractory and caustic-calcined grades) and magnesium salts offered a varied pattern in 1946. The high-cost magnesias enjoyed a good year owing to increased demands in the manufacture of synthetic rubber and medicinals. Precipitated magnesium carbonate, used mostly in 85-percent magnesia insulation, dropped, together with magnesium chloride. The latter salt has been declining in importance ever since cut-backs in the wartime magnesium metal program but probably was stabilized by the end of 1946. Further changes probably will be

[8] Pike, R. D., Process for Manufacture of Dead-burned Magnesite and Calcium Carbonate from Dolomite: Am. Inst. Min. and Met. Eng. Tech. Pub. 2155, March 1947, 11 pp.

increases. As only two producers reported magnesium sulfate production in 1946, figures for this salt may not be shown.

Owing to the difficulty of distinguishing light and extra-light magnesias statistically, the two have been combined in the accompanying table.

A new extinguisher for magnesium-metal fires consists of a mixture of talc, casein, and magnesium carbonate. It is shaken on the fire and fuses over it.[9]

Specified magnesium compounds produced, sold, and used by producers in the United States, 1945–46

Product	Plants	Produced (short tons)	Sold [1]		Used (short tons)
			Short tons	Value	
1945					
Specified magnesias (basis 100 percent MgO) and magnesium hydroxide, U. S. P. and technical:					
Extra-light and light magnesias	5	1,127	1,196	$488,570	----
Heavy magnesia and magnesium hydroxide	3	1,084	869	251,208	(2)
Total	[3] 5	[4] 2,211	2,065	739,778	(2)
Precipitated magnesium carbonate	11	50,205	8,469	812,791	41,794
Magnesium chloride, 100-percent basis	5	121,475	(5)	(5)	104,081
Magnesium sulfate, 100-percent basis	3	27,610	27,142	1,377,311	----
1946					
Specified magnesias (basis 100 percent MgO) and magnesium hydroxide, U. S. P. and technical:					
Extra-light and light magnesias	6	1,967	1,926	808,240	----
Heavy magnesia and magnesium hydroxide	4	1,874	1,620	416,775	(2)
Total	[3] 6	[4] 3,841	3,546	1,225,015	(2)
Precipitated magnesium carbonate	11	47,423	8,805	876,306	38,495
Magnesium chloride, 100-percent basis	3	32,137	(5)	(5)	(5)
Magnesium sulfate, 100-percent basis	2	(5)	(5)	(5)	----

[1] Sales by a producer to an affiliated consumer for immediate use are not included under "Sold" but are under "Used."
[2] Magnesium and magnesium hydroxide used by producing firms in making other magnesias are not shown.
[3] A plant producing more than 1 grade or product is counted but once in arriving at total.
[4] Exclusive of magnesia made from magnesium hydroxide, to avoid duplication.
[5] Bureau of Mines not at liberty to publish figures.

Magnesium compounds imported for consumption in the United States, 1942–46

Year	Magnesium chloride (anhydrous and n. s. p. f.)		Magnesium sulfate (epsom salts)		Oxide or calcined magnesia		Magnesium carbonate, precipitated		Magnesium salts and compounds, n. s. p. f.[1]	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1942	186	$115,025	----	----	16	$5,487	640	$70,756	13	$6,701
1943	----	----	----	----	(2)	1	122	17,730	21	16,645
1944	----	----	22	$1,812	30	9,485	151	26,703	22	12,799
1945	2	222	(3)	2	----	----	66	15,836	23	18,938
1946	38	1,539	(3)	2	50	16,205	145	23,428	11	8,991

[1] Magnesium silicofluoride or fluosilicate and calcined magnesium sulfate included under "Magnesium salts and compounds, n. s. p. f."
[2] 50 pounds.
[3] 20 pounds.

[9] Science News Letter, vol. 50, No. 9, Aug. 31, 1946, p. 136.

Magnesium hydroxide, medicinal grade, according to Oil, Paint and Drug Reporter, was quoted at 29 to 30 cents a pound in 1946 (the same as in 1945); magnesium carbonate, technical grade, bags, carlots, northern Atlantic Coast States, 7¼ cents a pound; U. S. P. grade, 8 cents (as in 1945). Magnesium chloride, flake, barrels, carlots, works, was quoted at $37 a ton, an increase of $5 over 1945. Epsom salt, technical, crystals, bags, carlots, per 100 pounds, was listed at $2.05 per hundredweight.

PART II.—MISCELLANEOUS SALINES

CALCIUM CHLORIDE

Sales of natural calcium (and calcium-magnesium) chloride set a new record in 1946 of 262,147 short tons, an increase of 20 percent over 1945. The major use of calcium chloride is in stabilizing dirt-road surfaces, where it binds soil particles together with its hygroscopic action, keeps down dust, and minimizes the formation of chuckholes. In the East a great deal is used (as the mixed calcium-magnesium chloride) to prepare heavy-media solutions for coal washing. Other traditional uses are in coal dusting, spraying on ore shipments in winter to inhibit freezing to a monolithic mass, sprinkling on snow and ice-covered streets, and in cement mixes. The housing boom of the past year has accentuated the latter use, and much attention has been given to speeding concrete-block production with calcium chloride. It is claimed that calcium chloride offers the following advantages in concrete block: Higher early strength, shorter curing period, reduced cracks, and greater ultimate strength. If steam curing is used, it is said that kiln time is cut in half. The chloride is added so as to comprise 2 percent of the cement mix. In air-entraining cements, calcium chloride partly offsets the loss in strength introduced with the entrained air.

Calcium chloride and calcium-magnesium chloride from natural brines sold by producers in the United States, 1942–46

[In terms of 75 percent (Ca, Mg) Cl_2]

Year	Short tons	Value	Year	Short tons	Value
1942	224,527	$1,733,169	1945	218,320	$1,818,219
1943	199,796	1,549,565	1946	262,147	2,278,954
1944	200,964	1,621,227			

Calcium chloride imported for consumption in and exported from the United States, 1942–46

Year	Imports		Exports	
	Short tons	Value	Short tons	Value
1942	1,443	$18,926	8,336	$223,184
1943	8,000	102,080	12,725	434,933
1944	2,761	35,125	8,535	234,329
1945	4,040	51,409	6,871	188,141
1946	1,313	14,587	10,073	367,993

Ten plants produced calcium chloride in 1946, the same as in 1945. The following firms reported production of calcium chloride (and calcium-magnesium chloride) from natural brines in 1946: California Rock Salt Co., 2436 Hunter Street, Los Angeles 21, Calif., plant at Amboy, Calif.; J. Q. Dickinson & Co., Malden, W. Va.; Dow Chemical Co., Midland, Mich.; Great Lakes Chemical Corp., Filer City, Mich.; Hill Brothers Chemical Co., 2159 Bay Street, Los Angeles 21, Calif., plant at Amboy, Calif.; Michigan Chemical Corp., St. Louis, Mich.; National Chloride Co., Amboy, Calif.; Rademaker Chemical Corp., Eastlake, Mich.; and Westvaco Chlorine Products Corp., 405 Lexington Avenue, New York 17, N. Y., plants at Chula Vista, Calif., and South Charleston, W. Va.

BROMINE

Bromine production dropped sharply in 1946 to the lowest level since 1939. The drop is attributed to reduced purchases of gasoline antiknock by the armed services in 1946. This halogen is used mostly in making ethylene dibromide, which is mixed with tetraethyl lead to form Ethyl gasoline antiknock compound.

Bromine and bromine in compounds sold or used by producers in the United States, 1942–46

Year	Pounds	Value	Year	Pounds	Value
1942	65,880,935	$13,729,383	1945	79,709,857	$14,796,229
1943	94,085,937	19,107,065	1946	42,783,327	8,560,434
1944	102,112,462	19,712,819			

Bromine and bromides sold by primary producers in the United States, 1945–46

	1945			1946		
	Pounds		Value	Pounds		Value
	Gross weight	Bromine content		Gross weight	Bromine content	
Elemental bromine	2,157,820	2,157,820	$379,336	2,657,355	2,657,355	$423,353
Sodium bromide	1,203,398	938,650	242,758	1,796,557	1,401,315	339,579
Potassium bromide	3,152,080	2,111,894	626,255	2,596,680	1,739,776	512,056
Ammonium bromide	482,749	395,854	108,930	541,926	444,379	119,443
Other bromides, including ethylene dibromide	87,484,382	74,105,639	13,438,950	43,353,081	36,540,502	7,166,003
	94,480,429	79,709,857	14,796,229	50,945,599	42,783,327	8,560,434

A striking development was the transfer of the Ethyl-Dow plant at Wilmington, N. C., to Freeport, Tex., thus enlarging the facilities at the latter locality. The Wilmington plant was the original bromine-from-sea-water plant, erected in 1933 and had been the largest individual producer, by far, since that time.

The Dow Chemical Co., Midland, Mich., second-largest producer, recovered bromine from Michigan well brines as a byproduct of magnesium and calcium chlorides. American Potash & Chemical Corp..

Trona, Calif., recovered bromine from Searles Lake, and Westvaco Chlorine Products Corp., Newark, Calif., from sea-water bitterns. The following won bromine from well brines: Great Lakes Chemical Corp., Filer City, Mich.; Michigan Chemical Corp., St. Louis, Mich.; Morton Salt Co., Manistee, Mich.; Rademaker Chemical Corp., Eastlake, Mich.; and Westvaco Chlorine Products Corp., South Charleston, W. Va.

According to Oil, Paint and Drug Reporter, potassium and sodium bromides, U. S. P., granular, 500-pound barrels, works, were quoted at 25 cents a pound in 1946, the same as in 1945.

IODINE

Receipts of foreign iodine (all from Chile) rebounded sharply from the abnormally low levels of 1945, although large stocks were still held in the Staten Island warehouse of the sole importer, Chile Nitrate Sales Corp. The two domestic producers, Dow Chemical Co. and Deepwater Chemical Co., Ltd., continued their recovery of iodine from oil-well waste brines near Long Beach, Calif., and supplied a substantial fraction of the United States market. The latest year for which data on domestic production may be published is 1937, when 299,286 pounds valued at $242,422 were produced. Subsequent output has been considerably higher.

The United States Pharmacopoeia in 1946 changed the iodine content of tincture of iodine from 7 percent to 2. The new concentration is said to be just as effective and will be less likely to damage skin tissue. Iodine is also used (in the form of iodides) in photographic emulsions, in organic syntheses, and in salt and other foodstuffs to prevent goiter. In the latter connection a bill (H. R. 2717) was introduced in Congress in 1946 to amend section 301 of the Food, Drug, and Cosmetic act, so as to require a specified iodide content (80 to 160 parts per million) in table salt moving in interstate commerce.

Crude iodine imported for consumption in the United States, 1942–46

Year	Pounds	Value	Year	Pounds	Value
1942	951,243	$1,051,432	1945	220,526	$232,070
1943	2,744,930	3,041,609	1946	886,578	976,190
1944	1,204,303	1,321,274			

The Bureau of the Census reported production of resublimed iodine (from both domestic and imported crude iodine) as follows: 1943, 770,000 pounds; 1944, 612,000; and first 9 months of 1945, 497,000. A figure for the complete year 1945 is not available, as the canvass was discontinued in the fourth quarter.

The price of crude iodine was frozen by the Office of Price Administration during most of 1946 at $1.28¼ per pound in 150-pound kegs; but after the price ceiling was removed in the general decontrolling order of November 12, effective November 10, the price soon rose to $1.42½ a pound. Resublimed iodine in 5-pound bottles sold at $2 to $2.10 a pound during the year, the same as in 1945.

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SODIUM COMPOUNDS

Sodium Carbonate.—The world-wide shortage of soda ash spurred the four California producers of natural sodium carbonates to a new record, with 215,625 short tons, 11 percent over 1945, the previous record year. The soda-ash demand from west coast glass and cleanser industries was greater than producers could supply and reflected the extremely tight situation that prevailed over the whole country. Some glassmakers even changed their batch formulas, substituting borax and salt cake for soda ash, in an attempt to relieve the pinch. An official of the Solvay Sales Co. stated that the present soda-ash capacity in the United States was 4,500,000 short tons annually, 42 percent greater than in 1940. Of this quantity, 3,200,000 tons were available for sale, the remainder being converted to caustic soda output. It was estimated that present expansion programs would increase soda-ash capacity 500,000 tons by 1948. The official said[10] that the alkali situation was unusually feverish because more soda ash was being taken for such things as glass containers and aluminum than in 1939; and alkalies generally are entering the newer products like synthetic rubber, acrylic resin, insecticides, and pharmaceuticals as well as the older standard items. Both producers and consumers expect the deficit to vanish by 1948.

The following firms reported production of natural sodium carbonates in 1946: American Potash & Chemical Corp., Trona, Calif.; Natural Soda Products Co., 506 Central Tower Bldg., San Francisco 3, Calif., plant at Keeler; Pittsburgh Plate Glass Co., Columbia Chemical Division, Bartlett, Calif.; and West End Chemical Co., 608 Latham Square Building, Oakland 12, Calif., plant at Westend.

The American Potash & Chemical Corp. announced plans to expand its soda-ash unit at Searles Lake by 60,000 tons annually (an increase of 75 percent).[11] The Natural Soda Products Co., subsidiary of the Wyandotte Chemical Co., working the brines of Owens Lake, intends to double its soda-ash capacity. The Kaiser interests also announced their intention of building a soda-ash plant on Owens Lake to supply indirectly the Kaiser (Permanente Metals Corp.) alumina plant at Baton Rouge, La. It is reported that the Kaiser organization has made a contract with the State of California for a 20-year lease for the extraction of 100,000 tons of soda ash per year from Owens Lake brines and will supply west coast customers of an eastern soda-ash producer, which will in turn supply the Baton Rouge plant.[12] The Westvaco Chlorine Products Corp., 405 Lexington Avenue, New York, N. Y., went ahead with the erection of a $3,000,000 plant to utilize large strata of trona at Green River, Wyo. It was reported that trona probably would be offered to the trade in 1947 and soda ash in 1948. Drilling cores have indicated an unusually pure material.[13]

Production data for sodium carbonate produced by the ammonia-soda process (as distinguished from natural sodas) for the last 5 years, according to the Bureau of the Census, are: 1942, 3,788,583 short tons;

[10] Chemical and Engineering News, vol. 25, No. 17, Mar. 24, 1947, p. 884.
[11] New York Times, American Potash to Widen Output, Nov. 27, 1946, p. L–35.
[12] Iron Age, vol. 159, No. 4, Jan. 23, 1947, p. 84.
[13] Mining Congress Journal, vol. 32, No. 7, July 1946, p. 70.

1943, 4,407,600; 1944, 4,538,398; 1945, 4,375,017; and 1946, 4,284,231 tons.

The price of soda ash, light, calcined, bags, carlots, works, was quoted at $1.20 a hundredweight in 1946, according to Oil, Paint and Drug Reporter. The 1945 price was $1.05 to $1.18.

Sodium Sulfate.—Natural sodium sulfate also enjoyed a record year, with sales reaching the unpredecented high of 198,781 short tons. The salt is used principally in the manufacture of kraft paper and glass, in stock feeds, as a flux in metallurgy, and wherever possible as a substitute for scarcer soda ash. Substantial quantities were required in 1946 in a comparatively new use—soapless detergents.

Natural sodium sulfates and sodium carbonates sold or used by producers in the United States, 1942–46

Year	Sodium sulfates [1]		Sodium carbonates [2]	
	Short tons	Value	Short tons	Value
1942	169,870	$1,669,983	150,619	$2,145,289
1943	160,622	1,553,549	165,993	2,544,086
1944	168,923	1,577,982	184,826	2,869,243
1945	178,196	1,525,159	194,045	3,034,118
1946	198,781	1,695,413	215,625	3,427,086

[1] Tonnage figures for sulfates include Glauber's salt converted to 100 percent Na_2SO_4 basis. Figures for 1942 include some burkeite.
[2] Soda ash and trona.

The following firms reported production of natural sodium sulfates: American Potash & Chemical Corp., Trona, Calif.; Arizona Chemical Co., 30 Rockefeller Plaza, New York 20, N. Y., plant at Brownfield, Tex.; Dale Chemical Co., 4031 Goodwin Ave., Los Angeles 26, Calif., plant at Dale Lake, Calif.; Iowa Soda Products Co., Council Bluffs, Iowa, plant at Rawlins, Wyo.; Ozark-Mahoning Co., Chemical Division, P. O. Box 449, Tulsa 1, Okla., plant at Monahans, Tex.; and Wm. E. Pratt, P. O. Box 738, Casper, Wyo.

Production of sodium sulfate in the United States, 1941–46, in short tons

[U. S. Bureau of the Census]

Year	Glauber's salt (100 percent $Na_2SO_4 \cdot 10H_2O$)[1]	Salt cake (crude) [1]	Anhydrous, refined (100 percent Na_2SO_4)	Total
1941	164,067	531,488	56,922	752,477
1942	199,962	570,869	71,784	842,615
1943	212,067	564,941	76,608	853,616
1944	231,200	564,889	69,997	866,086
1945	200,782	543,371	91,340	835,493
1946	167,153	527,746	122,573	817,472

[1] Includes natural sodium sulfate as shown in preceding table.

Estimated consumption of sodium carbonate in the United States, 1942–46, by industries, in short tons

[Chemical Engineering]

Industry	1942	1943	1944	1945	1946
Glass	1,100,000	1,200,000	1,290,000	1,320,000	1,400,000
Soap	165,000	150,000	162,000	150,000	120,000
Caustic and bicarbonate	960,000	1,010,000	1,033,000	1,114,000	1,128,000
Other chemicals	840,000	950,000	1,025,000	960,000	910,000
Cleansers and modified sodas	80,000	85,000	100,000	110,000	125,000
Pulp and paper	145,000	155,000	170,000	175,000	190,000
Water softeners	80,000	95,000	110,000	100,000	90,000
Petroleum refining	18,000	20,000	22,000	24,000	20,000
Textiles	56,000	58,000	61,000	68,000	77,000
Nonferrous metallurgy	260,000	450,000	320,000	200,000	140,000
Exports	230,000	370,000	79,000	70,000	68,000
Miscellaneous			320,000	290,000	222,000
	3,934,000	4,543,000	4,692,000	4,581,000	4,490,000

Domestic salt cake was quoted at $15 a short ton, bulk, works; anhydrous sodium sulfate at $1.70 per hundredweight, works; and Glauber's salt at $1.05 to $1.45 per hundredweight in 1946, according to Oil, Paint and Drug Reporter. Natural salt cake generally sells at prices somewhat lower than list quotations.

Sodium sulfate imported for consumption in the United States, 1942–46

Year	Crude (salt cake)		Crystallized (Glauber's salt)		Anhydrous		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1942	93,661	$1,324,256	22	$711			93,683	$1,324,967
1943	32,790	466,272			7	$477	32,797	466,749
1944	31,305	446,935					31,305	446,935
1945	20,293	289,940					20,293	289,940
1946	22,446	352,407					22,446	352,407

Sodium Metal.—Sodium metal is produced by only two firms, Ethyl Corp., 405 Lexington Avenue, New York, N. Y., plant at Baton Rouge, La., and E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., plant at Niagara Falls, N. Y.; therefore production data cannot be published. The former firm uses its output almost exclusively in the manufacture of tetraethyl lead—the gasoline antiknock—and the latter sells its production for a wide variety of uses, mainly chemical. A nonconfidential unpublished list supplied by the Civilian Production Administration for a sample war year names the following uses in order of importance: Tetraethyl lead, sodium cyanide, sodium peroxide, "Lorol" (a compound used in making synthetic rubber), drugs and pharmaceuticals, refining metals, and miscellaneous, which includes (not necessarily in order of volume) removal of antimony and arsenic from lead-tin alloys, increasing wetting power of molten metals for hot dip coatings, as a heat-transfer medium in the range 400° to 800° C., and in descaling steel.

The price of sodium metal in 1946 was 15 cents a pound in blocks, carlots, works, the same as in 1945.

Some interesting facts concerning the German sodium-metal industry were published by the Office of Military Government.[14] By April 1, 1944, the plant of the I. G. Farbenindustrie at Gersthofen was producing 650 metric tons of sodium monthly, using the Castner process, and the Degussa plant at Knapsack, using the more efficient Downs process, was also making 650 tons a month. Stocks on that date were 2,000 tons. As in the United States, the main use of sodium was in making a lead-sodium alloy, which in turn was reacted with ethyl chloride to produce tetraethyl lead and waste sodium chloride. The first-named paper outlines German research directed at methods to produce a lead-sodium alloy directly, without having to make pure sodium first. Some promising solutions to the problem were developed, but the country was invaded before research advanced beyond the pilot-plant stage. The main line of experimentation involved the electrolysis of molten salt floating on a bath of molten lead, whereby a lead-sodium alloy formed within the lead cathode and recoverable chlorine was given off at the anode.

BORATES

Boron minerals production set a new historical record in 1946, surpassing 1937, the previous record year, by 7 percent (B_2O_3 basis).

Salient statistics of the boron-mineral industry in the United States, 1942–46

	1942	1943	1944	1945	1946
Sold or used by producers: [1]					
Short tons:					
Gross weight	226,723	256,633	277,586	325,935	430,689
B_2O_3 content	77,600	87,600	91,700	104,600	129,800
Value	$5,733,648	$6,401,507	$6,579,587	$7,635,365	$9,575,866
Imports for consumption (refined): [2]					
Pounds				1,344	100,567
Value				$491	$4,077
Exports:					
Short tons	36,542	27,118	32,759	43,577	53,303
Value	$1,562,794	$1,350,834	$1,601,014	$2,064,065	$2,644,760
Apparent consumption: [3]					
Short tons	190,181	229,515	244,827	282,359	377,436

[1] Borax, anhydrous sodium tetraborate, kernite, boric acid, and colemanite.
[2] Also 525 pounds of crude valued at $7 in 1943.
[3] Quantity sold or used by producers plus imports minus exports.

In 1946 the following firms reported production of boron minerals: American Potash & Chemical Corp., Trona, Calif., on Searles Lake; Pacific Coast Borax Co., 510 West Sixth Street, Los Angeles 14, Calif., mine at Boron; Pittsburgh Plate Glass Co., Columbia Chemical Division, Bartlett, Calif.; United States Borax Co., 510 West 6th Street, Los Angeles 14, Calif., mine near Shoshone; West End Chemical Co.,

[14] Schermack, Leôn, Sodium in Germany and the Relations between I. G. and Degussa (English translation): Field Information Agency Technical (FIAT) Final Rept. 830, Aug. 6, 1946, 21 pp.
Gardiner, William C., Metallic Sodium from Sodium Amalgam at Gersthofen: Field Information Agency Technical (FIAT) Final Rept. 819, May 16, 1946, 18 pp.
Gardiner, William C., Degussa Sodium Production Using Downs Cells: Field Information Agency Technical (FIAT) Final Rept. 820. June 20. 1946. 17 pp.

608 Latham Square Building, Oakland 12, Calif., plant at Westend, on Searles Lake.

The largest producer, Pacific Coast Borax Co., reported itself unable to meet the demand for borax, boric acid, and rasorite, despite the increased output in 1946. Further production increases were planned for 1947. The firm reported greatly increased consumption of boron products in porcelain enamels, glass containers, and heat-resistant glass. Increases were also noted in demands for boron in fertilizers, synthetic detergents, and textiles.

The American Potash & Chemical Corp. announced plans for building more borax capacity in 1947–48. The increase would be 30,000 tons, or 30 percent over 1945 capacity.[15]

The price of technical borax, 99½ percent, granular, bulk, carlots, freight allowed, was raised in 1946 to $44.50–$47.50 a short ton, compared to $41.50 in 1945.

Foreign Boron Minerals.—Production of borates in Argentina fluctuates but has averaged about 9,000 metric tons in recent years.[16]

The single Chilean boron-producing camp, Cebollar, Province of Antofagasta, was reported somewhat active early in 1946. Shipments in 1945 were estimated at less than 500 tons compared with about 2,500 tons in 1944. The boron occurs in dry lakes and salt sinks as ulexite, and the B_2O_3 content ranges up to 35 percent, or 45 percent when calcined. The high content of impurities, such as sodium chloride and sulfate and calcium sulfate and carbonate, prevents active competition with borates produced in the United States. Reserves of Chilean borates have been estimated at 20,050,000 metric tons in the Provinces of Antofagasta, Tarapaca, and Atacama.[17]

[15] Chemical Industries, vol. 59, No. 6, December 1946, p. 1078.
[16] Bureau of Mines, Mineral Trade Notes: Vol. 23, No. 5, November 1946, p. 31.
[17] Bureau of Mines, Mineral Trade Notes: Vol. 23, No. 1, July 1946, pp. 27–28.

Manganese

By NORWOOD B. MELCHER [1]

GENERAL SUMMARY

IMPORTS of manganese ore into the United States established a record high in 1946, while consumption declined 23 percent from 1945 and was 29 percent less than in the peak year 1944. Domestic production, although high compared to the prewar level, dropped 21 percent from 1945; and fewer shippers were active than in any year since 1932, when less than 20,000 tons were shipped from domestic mines. The Government purchasing program inaugurated in 1940 (deliveries were begun in 1941) expanded during the war until, in the peak year 1943, 176 companies shipped manganese ore to Government stock piles. The program ended on December 31, 1945, when the last existing contracts were canceled. With the market restricted to private buyers, only 13 producers in the United States reported shipping ore to consumers during the calendar year 1946. Of these, 1 shipped both metallurgical and miscellaneous grades, 1 shipped battery-grade ore, 1 chemical only, and 10 metallurgical. Ninety percent of the total shipments was manganese nodules shipped by the Anaconda Copper Mining Co. from Anaconda, Mont. Because of the high grade of this material, it could be shipped many miles for use, and much was consumed in the Pittsburgh, Pa. area. This ore moved by rail to upper Lake ports and by steamer to Lake Erie ports.

Salient statistics of the manganese industry in the United States, 1925–29 (average) and 1942–46, in short tons

	1925–29 (average)	1942	1943	1944	1945	1946
Manganese ore:						
Total shipments containing 35 percent or more Mn	66,429	190,748	205,173	247,616	182,337	143,635
Shipments of metallurgical ore	[1] 46,919	177,966	195,096	241,170	174,295	134,381
Shipments of battery ore	19,510	12,377	9,973	6,224	8,042	[1] 8,295
Imports for consumption	672,000	1,583,024	1,511,630	1,315,677	1,311,346	1,514,544
Ferro-alloys:						
Production of ferromanganese	343,123	661,338	702,484	702,632	619,760	491,973
Imports of ferromanganese [2 3]	[4] 56,661	11,635	990	3,308	27,694	25,908
Production of spiegeleisen	106,919	186,026	149,036	165,530	139,039	111,696
Imports of spiegeleisen [2]	8,174	1,990	3,254	3,761	3,146	360
Exports of spiegeleisen and ferromanganese	4,221	7,223	12,824	802	3,209	10,464

[1] Includes small quantity of miscellaneous ore.
[2] Imports for consumption.
[3] Manganese content.
[4] Includes small quantity of other manganese alloys.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

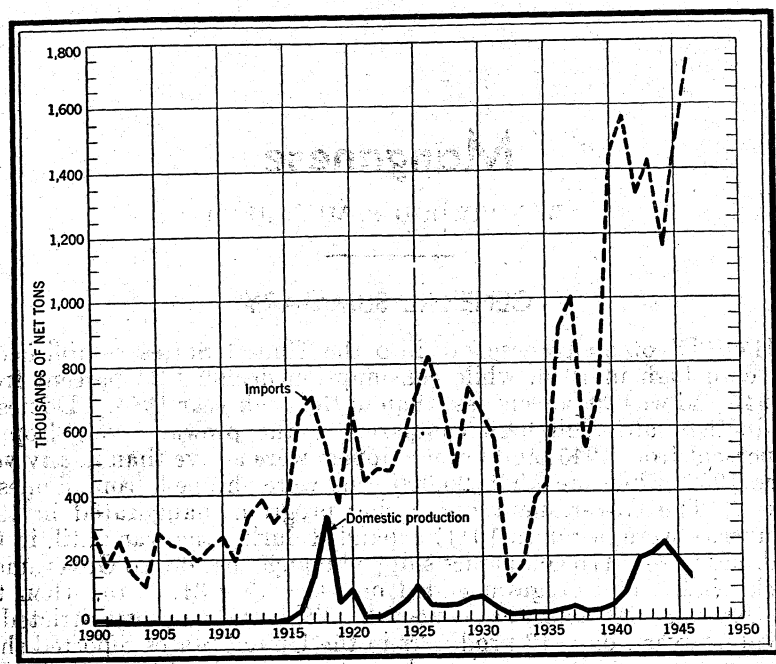

FIGURE 1.—Imports and domestic production (mine shipments) of manganese ore, 1900–46. Statistics on imports shown in the graph represent general imports for 1900–33, imports for consumption adjusted for changes in bonded warehouse stocks for 1934–39, and general imports for 1940–46.

The domestic output of manganese ore, as measured by shipments from mines, totaled 143,635 short tons in 1946 compared with 182,337 tons in 1945. The value of manganese ore shipped in 1946 totaled $4,811,068 ($33.50 per short ton) compared with $7,320,309 ($40.15 per short ton) in 1945. The reduction in average value of domestic shipments was a result of competition with imported ore, which was received at lower rates owing to elimination of war-risk insurance and accompanying lower freight rates; the import duty on foreign manganese ore remained unchanged. Only 7 States contributed to the total shipments in 1946 compared with 11 in 1945 and 13 in 1944. Shipments of ferruginous manganese ore (10 to 35 percent manganese) amounted to 100,489 tons and shipments of manganiferous iron ore (5 to 10 percent manganese) were 1,070,694 tons compared with 114,327 tons and 1,408,527 tons, respectively, in 1945.

The rate of receipts of foreign manganese ore in 1946 reached an all-time high, and 1,749,223 short tons of ore were imported. The largest supplier during the year was India, which increased its shipments to this country from 199,122 tons in 1945 to 371,753 tons in 1946. This increase was largely the result of improved shipping conditions to ports of embarkation. A critical shortage of railroad cars considerably retarded shipments from Indian mines during 1945. Shipments from Gold Coast and U. S. S. R. expanded during 1946

and receipts from Union of South Africa more than doubled. Notable among the countries that decreased their shipments to the United States was Cuba, from which receipts were only about one-half of the 1945 total. This decrease resulted from heavy depletion of reserves in that country during the war; and, unless new deposits are discovered, Cuba is destined to be only a minor supplier of manganese ore for United States consumption in the future. Chile, which was a negligible supplier of ore to the United States until recently, shipped 149,564 tons of ore during 1946 compared with 91,334 tons in 1945 and 4,289 tons in 1944.

Stocks of manganese ore held by the Office of Metals Reserve declined steadily throughout 1946. Adjusting the data reported by that agency to include an average of 4 percent moisture, 1,234,802 short tons were on hand at the end of the first quarter of 1946. At the end of the year this figure had been reduced to 1,095,427 tons.

During 1946 the Government again became a potential buyer of manganese ore when, under Public Law 663, signed by the President on August 8, 1946, Congress provided an initial appropriation of $100,000,000 for purchasing strategic and critical commodities. The Strategic and Critical Materials Division of the Procurement Division (Bureau of Federal Supply, after January 1, 1947) of the Treasury Department, under the direction of the Secretaries of War and Navy, was authorized under Public Law 520 (signed July 23, 1946) to make purchases for the stock-piling program. The Army and Navy Munitions Board announced a plan to complete the program within 5 years at a total cost of $2,100,000,000.[2] No statistical data have been published regarding tonnages secured or expenditures made under the stock-piling program.

Investigations of domestic manganese ore deposits and the utilization of domestic manganese have recently been made public.[3]

Naylor [4] studied the specific heats of manganese-copper alloys, and Kelley and others [5] studied the thermodynamic properties of manganese.

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[1] Niergarth, O. O., Minerals Raw Materials for Future Security: Metals, November 1946, pp. 6-8.

[2] Allen, Glenn L., Jacobs, J. H., and Hunter, J. W., Rasmussen, R. T. C., and Sillers, F., Jr., Utilization of Three Kids Manganese Ore in the Production of Electrolytic Manganese: Bureau of Mines Rept. of Investigations 3815, 1945, 78 pp.

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[4] Naylor, B. F., Heat Contents Above 25° C. of Seven Manganese-Copper Alloys: Bureau of Mines Rept. of Investigations 3835, 1946, 13 pp.

[5] Kelley, K. K., Naylor, B. F., and Shomate, C. H., The Thermodynamic Properties of Manganese: Bureau of Mines Tech. Paper 686, 1946, 33 pp.

DOMESTIC PRODUCTION

The following table shows the various types of manganiferous materials shipped by domestic producers from 1942 to 1946.

Manganiferous raw materials shipped by producers in the United States, 1942–46, in short tons

Year	Metallurgical ore				Battery ore	Miscellaneous ore
	Manganese ore (35 percent or more Mn)	Ferruginous manganese ore (10 to 35 percent Mn)	Manganiferous iron ore (5 to 10 percent Mn)	Manganiferous zinc residuum		
1942	177,966	265,663	1,500,613	292,051	15,410	473
1943	195,096	468,862	1,251,275	270,328	12,704	104
1944	241,170	296,981	1,190,476	247,402	6,224	377
1945	174,295	114,327	1,408,527	224,331	8,042	----
1946	134,381	100,489	1,070,694	205,786	[1] 8,295	[1] 1,959

[1] A small quantity of miscellaneous ore is included with battery ore.

Shipments of various grades of manganese-bearing ores during the last 5 years are given by States in the following tables. In addition battery and miscellaneous ores were produced intermittently in California, Georgia, Montana, South Carolina, Tennessee, and Virginia, and manganiferous zinc residuum was produced from New Jersey zinc ores.

Metallurgical manganese ore shipped from mines in the United States, 1942–46, by States, in short tons

State	1942	1943	1944	1945	1946	State	1942	1943	1944	1945	1946
Ala.	26	----	49	32	----	Oreg.	45	143	----	----	----
Ariz.	2,946	5,779	8,519	1,093	----	Pa.	22	----	----	----	----
Ark.	4,132	5,319	7,109	6,663	1,101	S. C.	----	312	1,400	41	78
Calif.	10,112	20,604	21,540	1,668	----	S. Dak.	81	12	----	----	----
Colo.	513	707	----	----	----	Tenn.	2,247	2,501	418	----	----
Ga.	4,890	2,467	1,135	1,056	----	Utah	970	91	30	----	----
Idaho	----	36	----	----	----	Va.	11,024	7,040	20,034	8,566	321
Mo.	239	180	----	----	----	Wash.	10,660	7,731	5,199	6,994	1,424
Mont.	120,409	130,789	153,665	143,888	129,227	W. Va.	2,240	----	----	----	----
Nev.	6,112	10,451	21,799	960	1,064	Wyo.	----	60	----	----	----
N. Mex.	1,267	469	273	3,334	1,166		177,966	195,096	241,170	174,295	134,381
N. C.	----	140	----	----	----						
Okla.	31	265	----	----	----						

Ferruginous manganese ore shipped from mines in the United States, 1942–46, by States, in short tons

State	1942	1943	1944	1945	1946	State	1942	1943	1944	1945	1946
Ala.	206	----	----	----	----	N. Mex.	89,009	72,967	100,683	85,744	72,299
Ariz.	----	498	320	56	----	N. C.	----	115	----	----	----
Ark.	14,067	8,207	14,755	14,806	1,964	Okla.	----	----	----	----	----
Calif.	4,659	8,492	4,598	12	----	S. C.	----	155	171	----	----
Colo.	44	----	----	47	----	Tenn.	916	803	6,779	1,000	----
Ga.	10,514	5,835	2,232	----	----	Tex.	142	----	----	----	----
Idaho	----	----	----	----	----	Utah	78	18	32,141	5,001	7,903
Mass.	3,301	----	----	----	----	Va.	3,905	12,208	4,419	392	87
Mich.	34,643	100,092	----	----	1,952	Wash.	----	----	----	----	----
Minn.	88,509	253,779	122,765	----	----	W. Va.	560	----	----	----	----
Mont.	15,468	2,041	781	5,057	3,816		268,764	471,593	297,136	114,327	100,489
Nev.	2,743	6,383	7,492	2,212	12,468						

Manganiferous iron ore shipped from mines in the United States, 1942–46, by States, in short tons

State	1942	1943	1944	1945	1946
Alabama	162				
Michigan			45,689	1,680	
Minnesota	1,500,451	1,251,275	1,144,787	1,406,847	1,070,694
	1,500,613	1,251,275	1,190,476	1,408,527	1,070,694

MINING BY STATES

Arkansas.—Manganese ore was shipped from Arkansas during 1946 from the Aydelotte mine by the Arkansas Manganese Co., the Southern Hill mine by R. B. Potashnick, the Polk Southard mine by the Polk Southard Mining Co., and C. C. Sims. Shipments totaled 1,101 short tons averaging 42 percent manganese. Ferruginous ore averaging 23 percent manganese was shipped by the Walter H. Denison Manganese & Contracting Co. and the Arkansas Manganese Co.

Michigan.—A total of 1,952 tons of ferruginous ore, containing (natural) 13.04 percent manganese, was shipped from Michigan. This shipment was made by the Oliver Iron Mining Co. from the Geneva mine on the Gogebic range.

Minnesota.—All of the manganiferous ore shipped from Minnesota during 1946 came from the Cuyuna range in Crow Wing County. Shipments totaled 1,070,694 tons, containing 6.31 percent Mn.

Montana.—The Anaconda Copper Mining Co. shipped 96 percent of the domestic metallurgical ore and 90 percent of the total domestic ore during 1946. All of the manganese-bearing material shipped by this company, except a very small tonnage of miscellaneous ore, was nodules from the Anaconda Reduction Works, Anaconda, Mont., averaging (natural) 60.28 percent Mn. The ore for nodulization (after concentration and calcining) came from the Emma and Travona mines at Butte. This ore (rhodochrosite) averaged approximately 20 percent Mn. All of the battery-grade ore produced in the United States during the year came from Montana and was produced by the Trout Mining Division of the American Machine & Metals, Inc., and the Taylor-Knapp Co., both in the Philipsburg district. Materials shipped from Montana during the year for battery use averaged (natural) about 67 percent MnO_2.

Nevada.—Manganese ore averaging (natural) 42 percent Mn was shipped by the Manganese Mining Co., from the Manganese Mining Co. mine, in White Pine County, Nev., during 1946. This ore was shipped to blast furnaces in the Birmingham, Alabama, district for consumption. Ferruginous ore averaging (dry) 29.91 percent Mn was shipped by the Charleston Hill National Mines Co., Golconda, Nev., and ore averaging (dry) 15.94 percent Mn was shipped from the Black Rock mine in Lander County by Western Alloys, Inc. All of the ferruginous ore was shipped to blast furnaces in Utah.

New Mexico.—The United Mining & Milling Co. shipped ore from its mill at Socorro, N. Mex., averaging (natural) 44 percent manganese during 1946. The Luck Mining & Construction Co. shipped ore from the Boston Hill mine, Grant County, to the Colorado Fuel & Iron Co., Pueblo, Colo. This ore averaged (natural) 12 percent Mn.

Manganese and manganiferous ores shipped from mines in the United States in 1946, by States

	Metallurgical				Battery				Miscellaneous				Total			
	Shippers	Short tons		Value	Shippers	Short tons		Value	Shippers	Short tons		Value	Shippers	Short tons		Value
		Gross weight	Manganese content			Gross weight	Manganese content			Gross weight	Manganese content			Gross weight	Manganese content	
Manganese ore: [1]																
Arkansas	4	1,101	461	$28,237									4	1,101	461	$28,237
Montana	1	129,227	77,893	(2)	2	[3] 8,295	[3] 3,504	(2)	1	(2)	(2)	(2)	3	137,522	81,397	4,643,050
Nevada	1	1,064	447	(2)									1	1,064	447	(2)
New Mexico	1	1,166	513	(2)									1	1,166	513	(2)
South Carolina	1	78	27	(2)									1	78	27	(2)
Virginia	1	321	125	(2)					1	959	389	(2)	2	1,280	514	(2)
Washington	1	1,424	678	(2)									1	1,424	678	(2)
Total	10	134,381	80,144	4,399,906	2	[3] 8,295	[3] 3,504	(2)	2	[3] 959	[3] 389	(2)	13	143,635	84,037	4,811,068
Ferruginous manganese ore: [4]																
Arkansas	2	1,964	454	(2)									2	1,964	454	(2)
Michigan	1	1,952	254	(2)									1	1,952	254	(2)
Montana	2	3,816	971	(2)									2	3,816	971	(2)
Nevada	2	12,468	2,689	(2)									2	12,468	2,689	(2)
New Mexico	1	72,299	9,037	(2)									1	72,299	9,037	(2)
Utah	1	7,903	2,134	(2)									1	7,903	2,134	(2)
Virginia									2	87	24	(2)	2	87	24	(2)
Total	9	100,402	15,539	(2)					2	87	24	(2)	11	100,489	15,563	517,265
Manganiferous iron ore: [5]																
Minnesota	3	1,070,694	67,545	2,609,446									3	1,070,694	67,545	2,609,446

[1] Containing 35 percent or more manganese (natural).
[2] Value included in total; Bureau of Mines not at liberty to show separately.
[3] A small quantity of miscellaneous ore is included with battery ore.
[4] Containing 10 to 35 percent manganese (natural).
[5] Containing 5 to 10 percent manganese (natural).

South Carolina.—A small shipment of ore averaging 35 percent manganese was made from the Dorn mine in McCormick County by the Abernathy & Kahaya Co.

Utah.—All of the ore produced in Utah during 1946 was shipped by the Ward Leasing Co. from the Black Boy mine in Jaub County. It averaged 27 percent manganese.

Virginia.—The Dominion Manganese Corp. shipped concentrates from the Old Dominion mine in Augusta County during 1946; all of the ore was used for chemical purposes. Metallurgical ore averaging (natural) 39 percent manganese was shipped by the Miller Manganese Mining Co. from the Miller mine in Bland County. A small quantity of chemical ore averaging (natural) 34.04 percent manganese was shipped by George W. Wheatley from the Pkin mine in Augusta County.

Washington.—Hausmanite ore averaging (natural) 47.6 percent manganese was shipped by the Manganese Division of the Sunshine Mining Co. from the Crescent mine in Clallam County during 1946.

IMPORTS OF MANGANESE ORE

Imports of battery-grade ore totaled 92,758 short tons in 1946. Of this quantity 47,990 tons came from Gold Coast, 36,919 tons from U. S. S. R., 6,709 tons from India, 1,028 tons from Mexico, and 112 tons from Chile. The ore averaged 54.55 percent Mn or 86.29 percent MnO_2. Imports for consumption of battery ore amounted to 85,595 tons, of which 43,056 tons came from Gold Coast, 36,919 tons from U. S. S. R., 4,480 tons from India, 1,028 tons from Mexico, and 112 tons from Chile. The value of these receipts totaled $1,869,778, or $21.84 per short ton, f. o. b. foreign ports. There were no reported entries or imports for consumption of ore containing less than 35 percent manganese in 1946, although 257 tons of ferruginous manganese ore and 5,854 tons of manganiferous iron ore (both from Mexico) were used during the year.

Manganese ore (35 percent or more Mn) imported into the United States, 1945–46, by countries

Country	General imports [1]				Imports for consumption [2]					
	Short tons				Short tons				Value	
	Gross weight		Mn content		Gross weight		Mn content			
	1945	1946	1945	1946	1945	1946	1945	1946	1945	1946
Brazil	282,086	160,171	119,500	66,386	242,275	86,015	115,916	38,985	$3,185,930	$1,122,840
Canada		17		8		17		8		770
Chile	91,334	149,564	42,699	68,066	91,334	143,498	42,699	65,222	2,553,691	4,491,443
Cuba	293,572	158,734	140,325	77,469	293,572	158,734	140,325	77,469	8,448,860	3,868,372
French Morocco		1		[3]		1		[3]		44
French West Africa		2,868		1,434						
Gold Coast	273,479	351,633	141,809	177,942	208,700	279,653	108,747	144,275	2,013,761	3,091,369
India and Dependencies	199,122	371,753	99,589	185,548	210,493	321,280	103,586	160,958	2,354,018	3,847,384
Mexico	46,377	30,701	20,638	13,980	51,646	39,760	22,240	18,570	1,154,300	1,004,014
Union of South Africa	124,630	281,861	57,448	133,580	61,981	243,666	29,544	113,037	1,098,460	3,988,310
U. S. S. R.	151,345	241,920	70,802	121,753	151,345	241,920	70,802	121,753	4,923,655	8,243,077
	1,461,945	1,749,223	692,810	846,166	1,311,346	1,514,544	633,859	740,277	25,732,675	29,657,623

[1] Comprises ore received in the United States during year; part went into consumption, and remainder entered bonded warehouses.

[2] Comprises receipts during year for consumption and ore withdrawn from bonded warehouses during year (irrespective of time of importation).

[3] Less than 1 ton.

CONSUMPTION AND STOCKS OF MANGANIFEROUS RAW MATERIALS

The consumption of manganese ore in 1946 decreased 23 percent from the total of 1,485,859 tons used in 1945. In 1946, 92 percent was of foreign origin compared with 90 percent in 1945. Industrial stocks of manganese ore on hand December 31, 1946, increased 71 percent over the 1945 total of 508,063 tons. The increase was due to the resumption of private purchases during 1946, whereas in previous years most ore was imported by the Government into stock pile and released to industry as necessity demanded.

The following table shows the actual tonnage of manganese ore (containing 35 percent or more manganese natural) and manganese alloys consumed during 1945 and 1946, by type of consumer, and stocks at the end of the year.

Consumption of manganese ore and manganese alloys in the United States, 1945–46, and stocks Dec. 31, 1946, gross weight in short tons

	Consumed		In stock Dec. 31, 1946 [1]	
	1945	1946	At plant, including bonded warehouses	In bonded warehouses
Manufacturers of manganese alloys and manganese metal:				
Manganese ore:				
Domestic	135,175	80,503	82,620	
Foreign	1,241,321	972,767	719,720	334,800
Total manganese ore	1,376,496	1,053,270	802,340	334,800
Ferromanganese			42,279	29,316
Spiegeleisen			5,948	
Silicomanganese			[2]	[2]
Manganese briquets			[2]	
Manufacturers of steel ingots and steel castings: [3]				
Manganese ore:				
Domestic	1,711	2,090	48	
Foreign	6,525	1,679	785	
Total manganese ore	8,236	3,769	833	
Ferromanganese:				
High-carbon	576,277	453,158	85,975	
Medium-carbon, Low-carbon	20,075	17,858	3,926	
Total ferromanganese	596,352	471,016	89,901	
Spiegeleisen	124,509	90,389	27,691	
Silicomanganese	54,272	47,155	9,063	
Manufacturers of steel castings: [4]				
Manganese ore:				
Domestic	204	274	58	
Foreign	720	431	466	
Total manganese ore	924	705	524	
Ferromanganese:				
High-carbon	31,455	21,780	6,989	
Medium-carbon, Low-carbon	1,638	918	454	
Total ferromanganese	33,093	22,698	7,443	
Spiegeleisen	10,473	7,751	2,237	
Silicomanganese	9,107	6,999	2,106	
Manufacturers of pig iron:				
Manganese ore:				
Domestic	673		516	
Foreign	19,460	10,059	12,465	
Total manganese ore	20,133	10,059	12,981	

See footnotes at end of table.

Consumption of manganese ore and manganese alloys in the United States, 1945–46, and stocks Dec. 31, 1946, gross weight in short tons—Continued

	Consumed		In stock Dec. 31, 1946 [1]	
	1945	1946	At plant, including bonded warehouses	In bonded warehouses
Manufacturers of miscellaneous products:				
Ferromanganese:				
High-carbon	9,721	6,362	2,960	
Medium-carbon }	2,456	1,184	997	
Low-carbon }				
Total ferromanganese	12,177	7,546	3,957	
Spiegeleisen	13,105	14,560	6,995	
Silicomanganese	963	747	3,446	1,564
Manganese briquets	4,689	4,834	2,254	210
Manufacturers of dry cells:				
Manganese ore:				
Domestic	7,844	8,497	1,531	
Foreign	50,999	39,104	37,957	21,967
Total manganese ore	58,843	47,601	39,488	21,967
Manufacturers of chemicals:				
Manganese ore:				
Domestic	74	5,096	614	
Foreign	21,153	16,187	13,767	
Total manganese ore	21,227	21,283	14,381	
Grand total:				
Manganese ore:				
Domestic	145,681	96,460	85,387	
Foreign	1,340,178	1,040,227	785,160	356,767
Total manganese ore	[5] 1,485,859	[5] 1,136,687	870,547	356,767
Ferromanganese:				
High-carbon	617,453	481,300		
Medium-carbon }	24,169	19,960	143,580	29,316
Low-carbon }				
Total ferromanganese	641,622	501,260	143,580	29,316
Spiegeleisen	148,087	112,700	42,871	
Silicomanganese	64,342	54,901	14,615	1,564
Manganese briquets	4,689	4,834	2,254	210

[1] Excluding Government stocks.
[2] Included under "Manufacturers of miscellaneous products."
[3] Includes only that part of castings made by companies that also produce steel ingots.
[4] Excludes companies that produce both steel castings and steel ingots.
[5] The greater part of the consumption of ore was used in the manufacture of ferromanganese and silicomanganese. Combining consumption of ore with that of ferromanganese and silicomanganese would result in duplication.

The following table shows ores available for consumption in the United States in 1946, without adjustment for changes in consumer or Government stocks.

Indicated consumption of manganiferous raw materials in the United States, in 1946

	Ore containing 35 percent or more Mn		Ore and residuum containing 10 to 35 percent Mn		Ore containing 5 to 10 percent Mn	
	Short tons	Mn content (percent)	Short tons	Mn content (percent)	Short tons	Mn content (percent)
Domestic shipments	143,635	58.5	306,275	14.8	1,070,694	6.3
Imports for consumption	1,514,544	48.9	[1] 257	34.8	[1] 5,854	([2])
Total available for consumption	1,658,179	49.7	306,532	14.8	1,076,548	6.3

[1] Estimated from consumption.
[2] Exact manganese content unknown.

METALLURGIC INDUSTRY

The use of manganese per short ton of steel produced dropped from 13.6 pounds in 1945 to 12.7 pounds in 1946 as a result of a decline in manganese steel production to virtually one-third of the 1945 level. Of the manganese used in steel during 1946, 11.1 pounds was in the form of ferromanganese, 0.5 pound as spiegeleisen, 1.0 pound as silicomanganese, and 0.1 pound as manganese ore used directly. In 1945 the consumption of manganese contained in ferromanganese, spiegeleisen, silicomanganese and manganese ore amounted to 12.0 pounds, 0.6 pound, 0.9 pound, and 0.1 pound, respectively per ton of steel. These data apply to consumption of manganese in the manufacture of steel ingots and that part of steel castings manufactured by companies that also produce steel ingots.

Electrolytic Manganese.—The Electro-Manganese Corp., Knoxville, Tenn., produced 2,120,943 pounds of electrolytic manganese, all from foreign ores, during 1946. This metal was used for a variety of purposes, ferrous and nonferrous. The Bureau of Mines at Boulder City, Nev., in furthering its research on the production and use of electrolytic manganese, produced 127,614 pounds during the year. The ore used in this operation was low-grade, averaging about 20 percent manganese, most of which came from the Three Kids mine, Clark County, Nev. Smaller quantities of ore from Chamberlain, S. Dak., Ladd mine, near Tracy, Calif., and Office of Metals Reserve stockpile ore containing material from Arizona, Arkansas, Montana, and New Mexico, were used successfully. This operation was discontinued May 29, 1946, and the plant was put in stand-by condition. Previous to 1946, 1,370,606 pounds of metallic manganese were produced at Boulder City. At the close of 1946 several companies other than Electro-Manganese Corp. had indicated an interest in the production of electrolytic manganese, but none of these was in commercial production.

Ferromanganese.—The domestic output of ferromanganese decreased 21 percent from 1945 and totaled 491,973 short tons. This alloy was produced at the following plants during the year: Bethlehem Steel Co., Johnstown, Pa.; Electro-Metallurgical Co., Alloy, W. Va., and Niagara Falls, N. Y.; E. J. Lavino & Co., Reusens, Va., and Sheridan, Pa.; The Pittsburgh Metallurgical Co., Charleston, S. C.; Sloss-Sheffield Steel & Iron Co., North Birmingham, Ala.; Tennessee Products Corp., Rockwood, Tenn.; Tennessee Coal, Iron & Railroad Co., Ensley, Ala.; and Carnegie-Illinois Steel Corp., Clairton and Etna, Pa. Of the 963,760 short tons of manganese ore used in the production of ferromanganese during 1946, 8 percent was of domestic origin compared with 10 percent in 1945. However, on a basis of the relative manganese content of foreign and domestic ore, 10 percent was made from domestic ore in 1946 compared with 12 percent in 1945. The recovery of manganese from ore in making ferromanganese was 85.01 percent in 1946 compared with 85.62 percent in 1945 and 85.76 percent in 1944. The average value, f. o. b. producers' furnaces, for ferromanganese shipped during 1946 was $124.25 compared with $129.28 in 1945. This decrease was made possible by a substantial drop in the delivered cost of manganese ore during 1946.

Ferromanganese and spiegeleisen imported into and made from domestic and imported ores in the United States, 1945–46, in short tons

	1945		1946	
	Alloy	Manganese content	Alloy	Manganese content
Ferromanganese:				
Imported	35,521	27,694	32,130	25,908
Domestic production	619,760	489,603	491,973	387,112
From domestic ore [1]	74,457	58,820	50,956	40,095
From imported ore [1]	545,303	430,783	441,017	347,017
Total	655,281	517,297	524,103	413,020
Ratio (percent) of Mn in ferromanganese of domestic origin to total Mn in ferromanganese made and imported		11.37		9.71
Number of plants making ferromanganese	10		11	
Spiegeleisen:				
Imported	3,146	[1] 629	360	[1] 72
Domestic production	139,039	27,446	111,696	22,597
From domestic ore	139,039	27,446	111,478	[1] 22,553
From imported ore			[1] 218	[1] 44
Total	142,185	28,075	112,056	22,669
Ratio (percent) of Mn in spiegeleisen of domestic origin to total Mn in spiegeleisen made and imported		97.76		99.50
Number of plants making spiegeleisen	5		3	
Total available supply of metallic manganese in ferromanganese and spiegeleisen		545,372		435,689
Percent of available supply of manganese in—				
Ferromanganese and spiegeleisen imported		5.19		5.96
Ferromanganese made from imported ore		78.99		79.65
Spiegeleisen made from imported ore				.01
Ferromanganese made from domestic ore		10.79		9.20
Spiegeleisen made from domestic ore		5.03		5.18
Ferromanganese and spiegeleisen made from domestic ore		15.82		14.38
Spiegeleisen made and imported		5.15		5.20
Total open-hearth, bessemer, and electric steel	79,701,624		66,602,724	

[1] Estimated.

Ferromanganese produced in the United States and metalliferous materials consumed in its manufacture, 1942–46

Year	Ferromanganese produced			Materials consumed (short tons)				Manganese ore used per ton of ferromanganese made (short tons)
	Short tons	Manganese contained		Manganese ore (35 percent or more Mn, natural)		Iron and manganiferous iron ores	Cinder, scale, and purchased scrap	
		Percent	Short tons	Foreign	Domestic			
1942	661,338	79.01	522,553	1,273,596	17,572	19,545	4,634	1.952
1943	702,484	78.98	554,828	1,181,929	199,567	1,684		1.967
1944	702,632	78.62	552,429	1,224,878	130,886	1,985		1.930
1945	619,760	79.00	489,603	1,111,075	120,420	5,364		1.987
1946	491,973	78.69	387,112	883,383	80,377	4,829		1.959

Manganese ore used in manufacture of ferromanganese in the United States, 1942–46, by source of ore

Source of ore	1942		1943		1944		1945		1946	
	Gross weight (short tons)	Mn content, natural (percent)	Gross weight (short tons)	Mn content, natural (percent)	Gross weight (short tons)	Mn content, natural (percent)	Gross weight (short tons)	Mn content, natural (percent)	Gross weight (short tons)	Mn content, natural (percent)
Domestic	17,572	39.69	199,567	57.86	130,886	59.06	120,420	57.05	80,377	58.66
Foreign:										
Africa	274,450	46.61	340,985	45.21	290,684	46.19	280,264	46.15	323,225	47.18
Brazil	342,538	41.55	254,215	39.72	227,410	41.02	275,117	41.19	161,456	40.98
Canada			44	45.00						
Chile	5,677	46.64	5,837	48.95	464	45.47	5,498	45.42	2,194	47.45
Cuba	171,029	46.33	194,780	45.91	241,582	47.45	257,521	45.37	165,951	46.53
India	340,096	49.75	255,897	49.10	246,044	49.36	164,568	48.87	163,764	48.16
Java	2,189	46.28								
Mexico	2,013	45.31	10,436	41.03	46,495	41.15	21,791	43.86	22,492	47.23
New Zealand					536	44.35				
Philippine Islands	19,741	46.05	27,233	46.04	8,144	52.00				
U. S. S. R.	64,051	48.06	3,129	45.19			12,452	44.49	296	44.59
Undistributed	[1] 51,812	45.75	[2] 89,373	49.21	[2] 163,519	48.58	[2] 93,864	48.59	[2] 44,005	48.94
	1,291,168	45.99	1,381,496	47.11	1,355,764	46.28	1,231,495	46.43	963,760	47.23

[1] Source of ore not reported by consumer.
[2] "Orient" reported by consumer as source of ore.

Shipments of ferromanganese in 1946 decreased 19 percent in quantity and 22 percent in value from 1945. The record of shipments for the past 5 years follows:

Ferromanganese shipped from furnaces in the United States, 1942–46

Year	Short tons	Value	Year	Short tons	Value
1942	659,219	$82,726,298	1945	610,376	$78,907,189
1943	722,658	93,481,580	1946	493,808	61,355,778
1944	715,059	91,406,229			

Imports for consumption of ferromanganese declined slightly from 1945, as the accompanying tables show.

Ferromanganese imported into and exported from the United States, 1942–46

Year	Imports for consumption [1]			Exports	
	Gross weight (short tons)	Mn content (short tons)	Value	Gross weight (short tons)	Value
1942	14,772	11,635	$1,274,749	7,165	$976,923
1943	2,302	990	160,600	12,510	1,717,888
1944	4,199	3,308	394,641	600	101,445
1945	35,521	27,694	3,733,846	836	175,556
1946	32,130	25,908	4,493,056	2,951	381,194

[1] All from India in 1943; all from Canada in 1942 and 1944–46 except—1942: 8,319 tons (6,595 content), $620,530 from United Kingdom; 1944: 1,408 tons (1,076 content), $98,282 from India; 1946: 9,357 tons (7,595 content), $1,585,803 from Norway.

Spiegeleisen.—Production of spiegeleisen in 1946 decreased 20 percent from 1945; shipments decreased 27 percent in quantity and 26 percent in value. Spiegeleisen was manufactured at the following plants during 1946: New Jersey Zinc Co., Palmerton, Pa.; Tennessee Coal, Iron & Railroad Co., Ensley, Ala.; and the Carnegie-Illinois Steel Corp., Duquesne, Pa. Virtually all of the spiegeleisen manufactured in 1946 was made from domestic materials. However, a small quantity of ore (122 short tons) from Portuguese West Africa was used. Imports of spiegeleisen in 1946 amounted to only 360 tons, valued at $17,512—all from Canada. The value of spiegeleisen, f. o. b. domestic furnaces, was $32.99 per short ton compared with $32.38 in 1945.

Spiegeleisen produced and shipped in the United States, 1942–46

Year	Produced (short tons)	Shipped from furnaces		Year	Produced (short tons)	Shipped from furnaces	
		Short tons	Value			Short tons	Value
1942	186,026	186,163	$5,931,728	1945	139,039	157,774	$5,108,144
1943	149,036	150,136	4,827,954	1946	111,696	114,982	3,793,673
1944	165,530	155,325	4,851,490				

Spiegeleisen imported for consumption in the United States, 1942–46

Year	Short tons	Value	Year	Short tons	Value
1942	1,990	$95,853	1945	3,146	$142,883
1943	3,254	140,247	1946	360	17,512
1944	3,761	153,032			

Manganiferous Pig Iron.—Pig-iron blast furnaces used 16,715 tons of manganiferous zinc residuum and 832,975 tons of domestic ore containing (natural) over 5 percent manganese in 1946. Of this ore, none contained 35 percent or more manganese, 223,153 tons contained (natural) 10 to 35 percent manganese, and 609,822 tons contained (natural) 5 to 10 percent manganese. In addition, 15,913 tons of foreign ore—of which 10,059 tons contained more than 35 percent manganese and 5,854 tons contained 5 to 10 percent manganese—were used during the year.

Foreign ferruginous manganese ore and manganiferous iron ore consumed in the United States, 1943–46, in short tons

Source of ore	Ferruginous manganese ore				Manganiferous iron ore			
	1943	1944	1945	1946	1943	1944	1945	1946
Cuba	9,509	1,844						
Mexico			800	257				5,854
	9,509	1,844	800	257				5,854

BATTERY AND MISCELLANEOUS INDUSTRIES

During 1946 manufacturers of dry cells in the United States used 47,601 tons of manganese ore, of which 8,497 tons were of domestic origin, and 39,104 tons were imported. Chemical plants used 5,096 tons of domestic ore and 16,187 tons of foreign ore containing (natural) more than 35 percent manganese. Most of this ore was used in the manufacture of manganese sulphate for fertilizer and in the manufacture of hydroquinone.

Manganese ore for battery use should have a high content of available oxygen with minimum iron and be relatively free from such metals as arsenic, copper, nickel, and cobalt, which are electronegative to zinc. Chemical ore has a wide range of analyses.

PRICES

The elimination of price control on manganese ore, effective November 10, 1946, under OPA order, had little or no effect on the price of manganese ore in the United States, as the sale price had previously been considerably under the ceiling fixed by the Office of Price Administration. Prices quoted by E&MJ Metal and Mineral Markets, at the close of 1946, per long-ton unit, for ore containing 48 percent manganese, subject to premiums and penalties, ranged from 70 to 71 cents, including duty. Chemical-grade per ton coarse to fine minimum, 80 percent MnO_2, Brazilian or Cuban, $55 in carlots to $60 to $65 barreled; Javan or Caucasian, 85 percent minimum, $70 to $75; domestic 70 to 72 percent, $45 to $50 in carlots, f. o. b. mines.

The long-ton unit upon which the price of manganese ore is based is 1 percent of a long ton, or 22.4 pounds of contained manganese. Prices of chemical ore are given on a per-ton basis with a minimum requirement of manganese dioxide. A duty of one-half cent per pound of contained manganese is imposed on all ore imported except that from Cuba and the Philippine Islands and that purchased by the United States Government, which enter duty-free.

WORLD REVIEW

The accompanying table shows, insofar as statistics are available, the world production of manganese ores, 1940 to 1946, and their average manganese content. Official statistics of the countries are used, supplemented by data from semiofficial and other sources.

Chile.—On October 17, 1946, a decree was published in the Diario Oficial declaring that manganese ore was essential to the national ferromanganese industry and that the production and sales of this raw material were subject to regulation. The decree was issued to assure an adequate supply to the domestic industry. Chile in 1946 supplied 9 percent of the manganese ore received in the United States.

Manganese ore produced in principal countries of the world, 1940–46, in metric tons [1]

[Compiled by B. B. Mitchell]

Country [1]	Percent Mn	1940	1941	1942	1943	1944	1945	1946
North America:								
Canada (shipments)		138		395	44			
Cuba	36–50+	119,852	251,385	249,255	[2] 311,214	[2] 257,864	198,243	130,103
Mexico	41–45	4,038	7,500	40,000	70,503	80,671	51,959	25,000
United States (shipments)	35+	40,767	79,646	173,043	186,129	224,632	165,412	130,303
South America:								
Argentina [3]	35–38	710	1,476	1,424	1,645	[4]	[4]	[4]
Bolivia (exports)	50		[4]	600	17			
Brazil	38–50	313,391	[5] 437,402	[5] 306,241	[5] 275,552	[5] 146,983	[5] 244,649	[5] 149,149
Chile	40–50	45,600	47,200	71,292	114,074	43,989	7,445	15,669
Europe:								
Bulgaria	30–45	2,000	[4]	[4]	[4]	[4]	[4]	[4]
Germany	30+	964	2,319	2,100	[4]	[4]	[4]	[4]
Greece	60–62	350	180	430	290	[4]	[4]	[4]
Hungary	35–48	24,830	26,380	31,880	33,580	[6] 21,050	[7] 6,600	16,940
Italy	34–37	50,986	59,773	60,163	[4]	[4]	15,389	[4]
Portugal	35–45	1,059	1,815	6,820	12,611	6,724	8,114	5,932
Rumania	30–36	34,158	15,032	29,021	37,417	[4]	[4]	[4]
Spain	40+	5,865	9,968	21,268	26,150	30,426	24,889	[4]
Sweden	30+	4,600	13,928	24,242	26,703	24,276	18,036	[4]
Switzerland		[4]	1,755	5,772	8,206	5,900	[4]	[4]
U. S. S. R.	41–48	2,800,000	[8] 2,393,000	[9] 1,823,000	[4]	[8] 461,000	[8] 2,251,000	[4]
United Kingdom		914	1,219	10,770	20,524	17,781	11,480	[4]
Yugoslavia	32–38	[4]	[10] 4,724	[4]	[4]	[4]	[4]	[4]
Asia:								
China	41	3,370	500	500	4,364	[4]	16,400	[11] 9,600
India:								
British	47–52	882,864	798,555	769,423	604,922	376,251	213,602	[4]
Portuguese	42–50+	6,525	8,111	680				[4]
Indochina	47–50	669	1,040	1,440	1,320	730	[4]	[4]
Iran [12]	45–55	2,320	3,270	1,800	[4]	[4]	[4]	[4]
Japan [13]	32–40	[14] 162,947	[14] 195,546	[14] 254,254	[14] 342,884	[14] 400,679	[14] 85,700	29,394
Netherlands Indies	50–55	11,569	[4]	[4]	[4]	[4]	[4]	[4]
Philippine Islands	35–48	52,166	[15] 50,570	[4]	[4]	[4]	[4]	
Turkey	30–50	460	1,360	3,313	2,687	1,865	3,552	1,793
Unfederated Malay States	30	19,345	[4]	[4]	[4]	[4]	[4]	[4]
Africa:								
Belgian Congo	50+	18,369	30,532	28,984	17,411	2,983		[4]
Egypt	30+	64,912	2,175	8,169	7,079	30	47	25
Eritrea	80	100						[4]
Gold Coast	50+	442,998	498,881	691,016	[2] 534,362	[2] 479,499	[2] [16] 347,103	[2] 721,396
Morocco, French	32–50	104,713	50,722	44,273	49,010	27,550	45,292	[4]
Northern Rhodesia	30–48	3,550	4,775	6,211	4,787	5,127	1,965	1,420
Portuguese West Africa	50	[4]	[4]	[4]	4,000	2,000		1,900
Tunisia	35–40		106	102		313		[4]
Union of South Africa	30–51	412,071	445,893	394,445	219,122	106,883	114,546	206,263
Oceania:								
Australia:								
New South Wales		1,024	1,485	793	614	782	1,000	[4]
Queensland		387	201	152	57	209	[4]	[4]
South Australia		10,827	12,138	9,477	5,680	1,219	[4]	[4]
New Zealand		996	964	326	518			[4]
Papua [17]		198	408	352	365	176	173	44
		5,659,000	5,479,000	5,101,000	3,984,000	2,761,000	3,861,000	[4]

[1] In addition to countries listed, Belgium, Costa Rica, and Spanish Morocco produce manganese ore, but data of output are not available. Czechoslovakia reports a production of manganese ore, but as it has been ascertained that the product so reported averages less than 30 percent Mn and therefore would be considered ferruginous manganese ore under the classification used in this report, the output has not been included in the table.

[2] Dry weight.

[3] Shipments by rail and river.

[4] Data not available; estimate included in total in 1940–1945.

[5] Exports.

[6] January to June, inclusive.

[7] June to December, inclusive.

[8] Estimate.

[9] Estimate excludes Ukraine.

[10] Croatia only.

[11] Incomplete data.

[12] Fiscal year ended March 20 of year stated.

[13] Preliminary.

[14] Fiscal year ended March 31 of year following that stated.

[15] January to September, inclusive.

[16] January to August, inclusive.

[17] Fiscal year ended June 30 of year stated.

Cuba.—At the close of 1946 the Cuban-American Manganese Corp. suspended the manganese nodules operations at its mine in Cuba owing to exhaustion of ore reserves. The corporation was dissolved and the assets distributed among its stockholders, the principal one being the Freeport Sulphur Co. The Cuban-American Manganese Corp. had produced virtually all of the Cuban manganese ore.

Egypt.—The three companies in Egypt producing manganese ore at present are the Sinai Mining Co., Alexandria; The Société Union de Misr, Cairo; and the Hamata Mining Co., Cairo. Most of the ore produced is "ordinary ore" averaging slightly less than 30 percent manganese and 25 percent iron. First- and second-grade ores, of which only small quantities are produced, run much higher in manganese and are reported to be satisfactory as metallurgical ore. Exports of all grades of manganese ore in 1945 are reported to have been 10,844 metric tons, of which 10,312 tons went to the United Kingdom; small quantities went to France, Palestine, and Syria.

Italy.—Manganese mines in the Province of Grosseto, about 90 miles northwest of Rome, are reported to be producing at capacity. These mines, owned by the Societa Anonima Mineraria Siderurgico of the Finalder group in prewar days, produced a small part of Italy's manganese supply, the total of which amounted to but 45 percent of its requirements. Output in March 1946 was 1,500 tons and a goal of 2,000 tons a month was announced. The ore from these mines goes to the iron industries of northern Italy and to blast furnaces at Naples.

Panama.—A contract was made public during 1946 between the Panamanian Government and Stuart St. Clair, New York, granting him a concession for mining manganese in the Province of Colon. Under the contract, the concessionaire must pay $5.00 annual tax on mining operations as covered by the fiscal code of the Republic, as well as 4 percent of the gross production of the mines to the Government. This can be paid in cash or in crude products at the option of the Government. He is exempted from paying national or municipal taxes on the capital employed in the exploration and from paying taxes on the operation of refining and on the importation of machinery and other necessary equipment. He also agrees to employ 75 percent Panamanian labor. St. Clair, accompanied by representatives of the Republic Steel Corp., visited the properties in Panama with the idea that Republic will enter into a contract for the exploration and extraction of manganese if the investigation proves favorable.

United Kingdom.—Consumers were reported to have received manganese ore in quantities sufficient to meet current demands. Selling prices were officially held at 1s. 2d. per unit c. i. f. on the basis of prewar freight and insurance rates. Buying prices are 1s. 2¾d. to 1s. 4¾d. on the same basis.[6] Electrolytic manganese was finding increased use in stainless steels made in the United Kingdom. Although about 50 percent more costly than metal produced by the thermic processes, it is found to produce a better surface to the steel and therefore to increase corrosion resistance.[7]

[6] Metal Bulletin (London), No. 3139, Oct. 25, 1946, p. 13.
[7] Metal Bulletin (London), No. 3147, Nov. 22, 1946, p. 5

Mercury

By HELENA M. MEYER AND ALETHEA W. MITCHELL

GENERAL SUMMARY

THE oversupply of mercury in the latter half of 1945 and the resulting price weakness were accentuated during 1946; the condition in mercury contrasted with that in most other mineral commodities. Mercury filled a not unfamiliar role in reacting to changed economic conditions before other metals.

Domestic production dropped 18 percent from 1945 and amounted to slightly less than half of the peak for the twentieth century, established in 1943; output, however, was 45 percent above the prewar average for 1935–39. Consumption fell 50 percent from the all-time record for 1945, but was 15 percent above the 1935–39 average. The shrinking world markets for mercury, caused primarily by the collapse of two of the chief world consumers—Germany and Japan—put added pressure on the United States market. Surplus metal from the war, large stocks at some European mines, and newly mined foreign mercury, particularly from Italy, urgently sought outlets during the year. The 1945 contracts for Spanish metal, to supply the huge United States war battery needs, were absent in 1946, however, and general imports dropped 68 percent. Over 8,000 flasks from surplus war stocks were shipped to the United States from Belgium in the latter half of the year but were held for reexport, so did not enter the United States market. Receipts from Italy rose from none in 1945 to over 10,000 flasks in 1946 as that country sent metal to the United States for the first time since 1940. On the whole, general imports, although 68 percent below the all-time peak (established by a substantial margin) in 1945, were at a high rate in relation to other peace years, probably exceeding all other such years except 1926 and 1927. The result of the foregoing factors, of large supply from domestic and foreign sources and of reduced consumption, was that industry could not use all of the metal available; new supplies exceeded consumption by 55 percent, and stocks rose. Stock gains in 1946 were invisible, however, because consumers' and producers' stocks showed no appreciable change, while Office of Metals Reserve inventories actually fell nearly 43,000 flasks. The absorption of metal into the permanent stock pile explains this apparent anomaly.

Figure 1 shows trends in production, consumption, and price of mercury from 1915 to 1946.

Although 51 properties contributed some metal to the United States total in 1946, 18 accounted for 98 percent; in the final quarter of the year 9 mines produced 97 percent. Some of those 9 mines were not operating continuously. Rising costs and falling prices have closed most mines, and some of the present producers are believed to be operating at a loss.

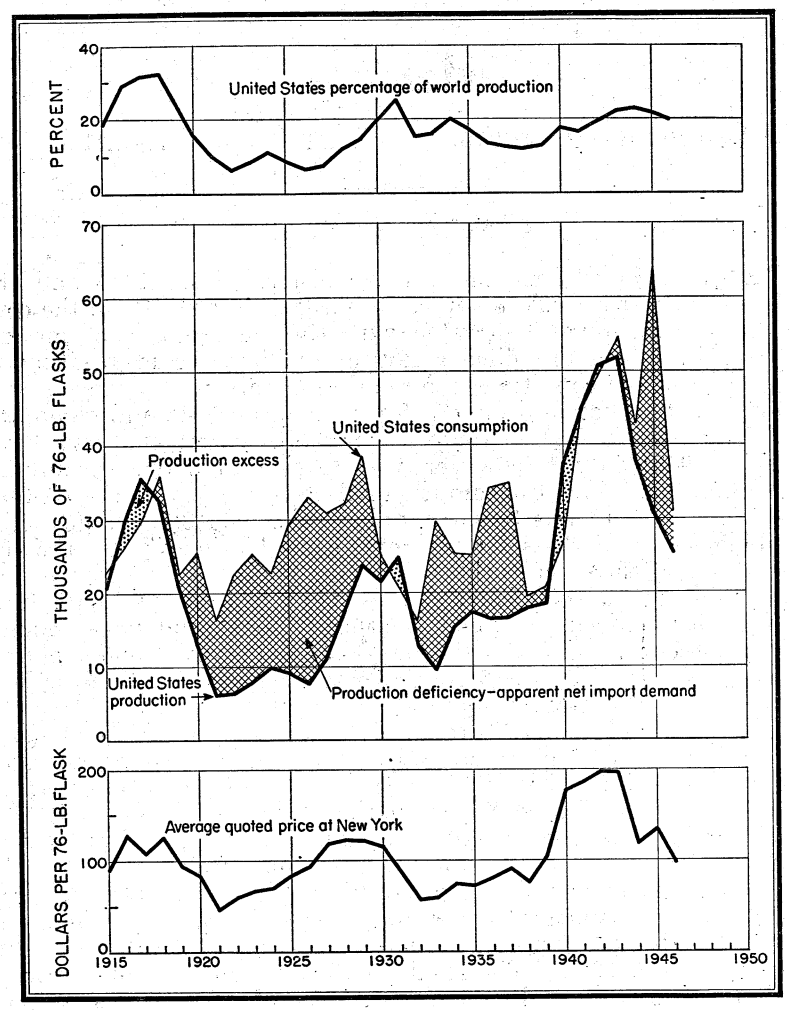

FIGURE 1.—Trends in production, consumption, and price of mercury in the United States, 1915–46.

The average monthly quoted price for mercury was $105 a flask in January and fell to $88 in December, the lowest monthly average since August 1939. Based on the Bureau of Labor Statistics index for all commodities, the December price was equivalent to only $56 in 1939 purchasing power.

The new-type cell, the increased consumption of which for peacetime purposes has been one of the chief hopes of the industry, did not fulfill the expectations of some observers in 1946. Production of the cells for several types of military batteries and for hearing-aid use was under way during the year, but manufacturers' efforts were directed largely to developing new designs and to more economical practice. A substantial consumption, although far less than in the last year of war, was claimed, by one authority, to be in prospect.

Salient statistics of the mercury industry in the United States, 1942–46

[Flasks of 76 pounds]

	1942	1943	1944	1945	1946
Production.....flasks	50,846	51,929	37,688	30,763	25,348
Number of producing mines	184	146	102	68	51
Average price per flask:					
New York	$196.35	$195.21	$118.36	$134.89	$98.24
London	$227.87	$281.44	$281.44	$242.45	$120.39
Imports for consumption:					
Pounds	[1] 2,959,489	[1] 3,633,216	1,486,025	5,214,890	1,055,956
Equivalent flasks	[1] 38,941	[1] 47,805	19,553	68,617	13,894
Exports:					
Pounds	[1] 26,252	[1] 29,236	57,007	78,852	68,932
Equivalent flasks	[1] 345	[1] 385	750	1,038	907
Consumption.....flasks	49,700	54,500	42,900	[2] 62,429	31,200

[1] Large quantities reexported in 1942 and 1943 are included in imports but not exports.
[2] Revised.

Output in all important mercury-producing countries except Italy was virtually the same or smaller in 1946 than in 1945, and the world total was only half of the all-time record for 1941. Italy, however, produced less in 1946 than in 1939, while Spain, the United States, and Mexico continued to exceed prewar levels. Italy's gain over 1945, in the face of reduced prices and shrinking world markets, was due to an urgent need for foreign exchange.

Efforts were made to reestablish the international mercury cartel, Mercurio Europeo, and several agents have been appointed. More details are given under World Review.

DOMESTIC PRODUCTION

Mercury production in the United States was maintained substantially above prewar output in 1946 despite the sharp contraction in consumption, the abundance of importable metal pressing for a market, and the falling price. A total of 25,348 flasks was produced, representing a decline of 18 percent from 1945 but a 45-percent increase over the prewar annual average for 1935–39, inclusive. The average quoted price of mercury at New York was $98.24 a flask in 1946 compared with $103.94 in 1939. According to the Bureau of Labor Statistics, the index for all commodities in 1939 was 77.1, whereas in 1946 it was 121.1. Thus, the 1946 average of $98.24 was equivalent to less than $63 in 1939 purchasing power. At the end of the year the price was $88–$92 a flask and continued downward in early 1947. The rate of output at the year end was not determined, but only a few mines were known to have been in operation at that time.

Declines of 16 and 47 percent in California and Oregon, respectively, were offset in part by gains of 5 and 38 percent in Nevada and Idaho. California's output was the smallest since 1939 and Oregon's since 1926, when none was reported. Production in Nevada was smaller than in the high years, 1929, 1940, and 1942 but was virtually at the level of 1943, the fourth highest year.

The principal producing mines in 1946 were as follows:

Alaska—Red Devil and Decoursey Mountain mines.
Arizona—Gila County, Ord mine.

California—Contra Costa County, Mount Diablo mine; Fresno County, Archer mine; Lake County, Abbott mine; Napa County, Knoxville mine; San Benito County, New Idria mine; Santa Clara County, Guadalupe mine and Almaden dumps; Sonoma County, Culver-Baer, Dewey-Geyser and Mount Jackson mines; Yolo County, Reed mine.
Idaho—Valley County, Hermes mine.
Nevada—Humboldt County, Cordero mine; Pershing County, Red Bird mine.
Oregon—Douglas County, Bonanza mine.

In 1946 those 18 mines produced 98 percent of the United States total; in 1945, 20 mines produced 97 percent, but in 1942, 34 mines produced only 89 percent. The leading producers in 1946 accounted for at least 95 flasks each. Very few properties were producing as the year ended. In the fourth quarter, for example, 9 mines—the Mount Diablo, Archer, New Idria, Guadalupe, Mount Jackson, Reed, Hermes, Cordero, and Bonanza—produced 97 percent of the United States total. Some of these mines were not operating continuously.

Mercury produced in the United States, 1940–45, by months, and 1946, by quarters, in flasks of 76 pounds

Month	1940	1941	1942	1943	1944	1945	1946
January	1,800	3,100	3,700	4,200	4,400	2,500	
February	2,200	2,900	3,400	3,900	3,800	2,700	5,550
March	2,500	3,500	4,100	4,600	3,800	3,000	
April	2,700	3,500	4,200	4,600	3,700	3,000	
May	3,100	3,600	4,800	4,200	3,400	3,300	7,000
June	3,000	4,000	4,900	4,100	3,000	3,000	
July	3,200	3,400	4,700	4,300	2,700	3,600	
August	3,500	4,100	4,500	4,500	2,500	3,300	6,500
September	3,600	4,200	4,200	4,500	2,500	2,050	
October	3,600	4,000	4,100	5,200	2,700	1,200	
November	3,400	3,800	4,100	5,000	2,300	1,350	6,150
December	3,700	3,900	4,400	4,200	2,500	1,600	
	[1] 37,777	[1] 44,921	[1] 50,846	[1] 51,929	[1] 37,688	[1] 30,763	[1] 25,348

[1] Final annual figure; monthly and quarterly totals not adjusted.

Mercury produced in the United States, 1943–46, by States

Year and State	Producing mines	Flasks of 76 pounds	Value [1]
1943:			
Alaska	3	786	$153,435
Arizona	3	541	105,609
Arkansas	18	1,532	299,062
California	65	33,812	6,600,440
Idaho	1	4,261	831,790
Nevada	33	4,577	893,476
Oregon	16	4,651	907,922
Texas	7	1,769	345,326
	146	51,929	10,137,060
1944:			
Arizona	3	548	64,861
Arkansas	8	191	22,607
California	58	28,052	3,320,235
Nevada	17	2,460	291,166
Oregon	8	3,159	373,899
Texas	4	1,095	129,604
Alaska and Idaho	4	2,183	258,380
	102	37,688	4,460,752
1945:			
California	39	21,199	$2,859,533
Idaho	1	627	84,576
Nevada	12	4,338	585,153
Oregon	6	2,500	337,225
Alaska, Arizona, Arkansas, and Texas	10	2,099	283,134
	68	30,763	4,149,621
1946:			
Alaska	2	699	68,670
Arizona	1	95	9,333
Arkansas	2	11	1,081
California	32	17,782	1,746,904
Idaho	1	868	85,272
Nevada	7	4,567	448,662
Oregon	6	1,326	130,266
	51	25,348	2,490,188

[1] Value calculated at average price at New York.

The average grade of ore treated in 1946 continued the uptrend of recent years. In 1946 the average grade was 0.6 percent (12-pound ore) compared with 0.54 percent (10.8-pound ore) in 1945, 0.47 percent (9.4-pound ore) in 1944, 0.31 percent (6.28-pound ore) in 1943, and 0.25 percent (5-pound ore) in 1942. In reviewing the quicksilver industry in 1946, Williston [1] stated:

> * * * If the average grades of ore mined in the western states were anything like the grades produced before the war the industry would be completely closed down. The only reason that any of the mines are able to continue to operate is the result of extensive new discoveries of large bodies of high grade ore, discovered and developed during the latter part of the war period. Increased costs and declining prices have already turned over half of these reserves from ore to waste and since they are marginal to the ores now extracted from the stopes, in all probability these reserves will be lost for all time. * * *

In addition to that produced at mines in 1946, almost 4,000 flasks of mercury were reported as produced from battery scrap and calomel. Additional unreported quantities are believed to have been recovered.

REVIEW BY STATES

Alaska.—Mercury was produced in 1946, as in 1945, by the Red Devil (New Idria-Alaska) and Decoursey Mountain mines, the former in a Gould rotary furnace and the latter in retorts. Developed reserves at the Red Devil were virtually worked out at the end of 1946, and further operations at the mine were reported to depend on higher prices.

Arizona.—At the Ord mine in the Brown district, Gila County, 760 tons of ore were produced and furnaced to recover 95 flasks of mercury. A 25-ton Foster furnace is used at this mine, which was the sole surviving producer of the seven that operated in 1942.

Arkansas.—Only two properties are reported to have mined and treated mercury ore in 1946, the Ajax and Hintze, both in Pike County, the former utilizing a Cottrell rotary furnace and the latter a home-designed retort. A total of 11 flasks was recovered. Considerable mercury was recovered from battery and other war scrap in the Hintze plant and in the 8-ton rotary furnace at the National mine, also in Pike County. The precise quantity thus recovered is not known.

California.—United States production of mercury continued to be dominated by California, which supplied 70 percent of the total, a reduction from the recent peak of 74 percent in 1944. Production dropped 16 percent in 1946 or slightly less than the decline for the United States as a whole. Thirteen counties contributed to the output in 1946, as follows: Contra Costa, Del Norte, Fresno, Kings, Lake, Napa, San Benito, San Luis Obispo, Santa Barbara, Santa Clara, Sonoma, Trinity, and Yolo.

The Bradley Mining Co. again treated ore in a 40-ton rotary furnace at the Mount Diablo mine, Contra Costa County, and in 1946 increased its output of mercury substantially over 1945, against the trend for most companies.

The Patricks Creek mine, Del Norte County, was operated by Oscar E. Hanno and produced mercury during part of the year. Hanno is reported to have sold his property.

[1] Williston, S. H., The Outlook for Quicksilver: Min. Cong. Jour., vol. 33, No. 2, February 1947, p. 95.

Mercury ore was produced at the Archer mine, Fresno County, and trucked to the New Idria plant, San Benito County, for furnacing. The Archer Mining Co. reported that 139 flasks were produced from 742 tons of ore.

A small production is believed to have come from the Kings mine, Kings County, in 1946.

Lake County has dropped sharply in importance as a mercury-producing county since 1944, when it ranked second only to San Benito among counties in the United States. A large decline in output at the Abbott mine, which resumed importance as a mercury producer during the war (standing third in the country in 1944), the sharply lowered rate of production at the Sulphur Bank mine, and the closing of the Mirabel mine were chiefly responsible for the drop. Seven mines contributed to the totals of 4,288 tons of ore and 633 flasks from ore and clean-up, compared with 9,556 tons and 1,447 flasks in 1945. The Abbott stood first in the county again in 1946; its ore was treated in a 40-ton rotary furnace. The mine was closed in August, but resumption of the development program was expected. Furnaces were used also at the other properties mentioned, except Mirabel, where output was from dismantling of the plant. Other producers were the Helen, Great Western, McGuire Peak and Baker mines, of which the first two named used furnaces. A new discovery was reported (100 yards from any workings) at the Helen mine.

The Sulphur Bank mine was described [2] in a recent report. The mine is said to have produced 126,285 flasks of mercury to the end of 1944. The report stated:

* * * Economic studies have shown that the mounting costs of open-pit mining demand a floor price of $200 per flask for continued successful operation, and even at this high price, no assured ore was in sight at the end of 1944. Indicated reserves total 18,420 flasks from about 115,000 tons of ore, and 15,750 flasks may be obtainable from 150,000 tons of inferred ore. * * *

Another report [3] described the Eastern Mayacmas district, part of which is in Lake County, stating that the entire Mayacmas district, which includes parts of Lake, Napa, and Sonoma Counties, has produced 455,000 flasks of quicksilver since 1864 and is the second most-productive quicksilver district in the United States. The report says that measured ore is negligible, because very little ore is developed in advance of mining, and estimates that the district, although past its zenith, is capable of producing 2,000 to 4,000 flasks annually for several years during periods of high prices.

Two operators at the Knoxville mine (Cerar, Carr & Truitt, and Hickox & Wilson) and the Oat Hill Extension mine produced all of Napa County's output in 1946. A 40-ton furnace was used at the Knoxville. One of the few county increases in the country was made in Napa County, largely because of larger output at Knoxville. Four small producers in 1945 did not report any output in 1946.

San Benito County stood preeminent among mercury-producing counties in the United States again in 1946, with an output of 37,504 tons of ore and 8,269 flasks of mercury, almost entirely because of the

[2] Everhart, D. L., Quicksilver Deposits at the Sulphur Bank Mine, Lake County, Calif.: California Jour. Mines and Geol., vol. 42, No. 2, April 1946, pp. 125–153.

[3] Yates, R. G., and Hilpert, L. S., Quicksilver Deposits of Eastern Mayacmas Dist., Lake and Napa Counties, Calif.: California Jour. Mines and Geol., vol. 42, No. 3, July 1946, pp. 231–286.

production of the New Idria mine, largest producer in the Western Hemisphere. In 1945 the county produced 45,855 tons of ore and 10,193 flasks of mercury (including a small quantity from clean-up and dumps); and the recent peak output was 14,187 flasks in 1943. Three small properties also contributed to the county total in 1946. Four Gould rotary furnaces and condensing systems are at the New Idria, but the plant operated at far below capacity in 1946. Other producers in 1946 were the North Star, Valley View, and one other mine.

Three small operations accounted for an output of 40 flasks of mercury in San Luis Obispo County in 1946 compared with three properties (not identical) and 873 flasks in 1945. The Buena Vista mine, which dominated output in 1945, was unproductive in 1946.

Mercury was produced in a retort at the Red Rock mine in Santa Barbara County in 1946; the plant was closed during the summer.

Larger production at the Guadalupe mine, Santa Clara County, placing it sixth in the United States, was inadequate to offset the failure of the New Almaden mine, largest in the county in 1945, to produce in 1946. At the Guadalupe mine in 1946 an 80-ton Gould rotary furnace and 8-tube retort were in use. Other producers were the Almaden dumps, Chaboya mine, two small properties, and a little plant clean-up from the New Almaden mine. The totals for the county were 863 flasks of mercury from 12,693 tons of ore and 340 flasks from dumps and plant clean-ups.

The Mount Jackson mine again dominated the output of Sonoma County by a substantial margin and once more ranked as the third largest United States producer. The county produced 37,519 tons of ore and 3,222 flasks of mercury, compared with 33,868 tons and 3,324 flasks in 1945. Mount Jackson is 3½ miles from Guerneville in the Guerneville district. Ore is treated in a Gould rotary furnace. Other producers in 1946 were the Culver-Baer mine, 25 miles south of Healdsburg, where a 20-ton rotary was used, and one other. The Western Mayacmas district was the subject of a report [4] published in 1946.

A small production is reported to have been made during the year at the Altoona mine, Trinity County.

The Reed mine, fourth in the country, as in 1945, was again the only producer in Yolo County; Reed's output gained 8 percent in 1946, against the trend at most properties in the United States.

Idaho.—Bonanza Mines, Inc., produced and treated 7,219 tons of ore at the Hermes mine in 1946 and recovered 868 flasks of mercury, an increase over the output in 1945. The mine is in the Yellow Pine district, Valley County; it was the only producer of mercury in Idaho in 1946, as in 1945. The mine is equipped with two 4- by 60-foot Gould rotary furnaces. A total of 1,500 feet of underground development work was reported as done during the year.

Nevada.—Output of mercury in Nevada was dominated again in 1946 by the Cordero mine, which was chiefly responsible for Nevada's rise of 5 percent against the downtrend for the United States as a whole. Nevada ranked second in production for the second successive year. Production in 1946 was virtually the same as in 1943, which ranked below only the high years 1929, 1940, and 1942.

[4] Bailey, E. H., Quicksilver Deposits of the Western Mayacmas Dist., Sonoma County, Calif.: California Jour. Mines and Geol., vol. 42, No. 3, July 1946, pp. 199–230.

L. V. Pangburn produced a small quantity of mercury in a retort at the Silver Fox mine, Ivanhoe district, Elko County.

W. F. Dunnigan produced and treated 100 tons of ore in a 30-ton Gould rotary furnace at the Red Rock mine, Fish Lake Valley district, Esmeralda County, and recovered 7 flasks of mercury.

In 1946 the Cordero mine, Opalite district, Humboldt County, maintained the second-place position gained in 1945. Production of the county, which rose slightly, was second only to that of San Benito County, Calif., owing to Cordero's performance. Production at Cordero is made in a 100-ton Herreshoff furnace. Two small operations in Humboldt County were also productive.

Melvin McCoy operated the Goldbanks mine, Goldbanks district, Pershing County, again in 1946, and produced, in a retort, 47 flasks from 200 tons of ore. Bratton and Blair operated the Red Bird mine in the Antelope Springs district.

Oregon.—Oregon remained the third most important mercury-producing State in 1946, having fallen in 1945 from second place, a position held since 1936. The Bonanza mine continued to dominate the State's output, having produced 95 percent of the total. The Oregon State Department of Geology and Mineral Industries issued a map in 1946 showing all known quicksilver deposits in Oregon.

Eickemeyer Bros. treated high-grade ore again in a retort at the Maury Mountain mine, Ochoco district, Crook County. A total of 6 tons of ore was produced and treated and 21 flasks of mercury recovered. The only other producer in the county was Frank S. Towner.

The Bonanza mine, operated by Bonanza Mines, Inc., was again, by a wide margin, the chief mercury-producing property in Oregon; it ranked fifth in the United States. The property is in the Sutherlin district, Douglas County. In 1946, 8,034 tons were produced and 8,188 tons treated in a Gould rotary furnace and 1,261 flasks of mercury recovered. Although Bonanza ranked fifth in 1946, the output in that year marked the sixth successive decline.

Officer Bros. produced one flask of mercury at the Snow Drift No. 1 mine, Harney County. A small output of mercury was made at the War Eagle mine in Jackson County.

The Bureau of Mines issued [5] a report on the Glass Buttes mercury deposit. The area has not been explored thoroughly, according to the report, and no mercury has been produced from any of its deposits.

Clean-up operations of the mill surface dumps at the Opalite mine, Opalite district, Malheur County, resulted in production in 1946.

Texas.—Exploratory work of the Bureau of Mines in Brewster and Presidio Counties was described [6] in a recent report. The report

[5] Reed, G. C., Exploration of Glass Buttes Mercury Deposit, Lake County, Oreg.: Bureau of Mines Rept. of Investigations 3926, 1946, 4 pp.

[6] Evans, A. M. and Traver, W. M., Terlingua Mercury Deposit, Brewster and Presidio Counties, Tex.: Bureau of Mines Rept. of Investigations 3995. 1947. 10 pp.

notes that both the Geological Survey and the Bureau of Mines concluded that, with but few exceptions, known ore bodies in the famous Chisos mine had been exhausted and that the area south and east of the mine workings was most favorable geologically for finding additional ore deposits. No production in Texas was reported in 1946.

CONSUMPTION AND USES

Mercury consumption in 1946 dropped to about half of the peak quantity for 1945, owing largely to the cancellation of war battery contracts in mid-1945. The use of mercury continued at higher than prewar levels, however, being 15 percent above the 1935–39 average. As stated in the opening section of this report, hopes that the new dry-cell would consume substantial quantities of mercury were not fulfilled in 1946. Several types of military batteries and hearing-aid batteries that use the new cell were in production during the year. Producers' efforts were concentrated on the development of new designs and more economical manufacture, and noteworthy progress was reported. A substantial future business was reported to be in prospect.

New effectiveness and economy in the control of slime in paper mills were forecast [7] by a manufacturer of pyridylmercuric acetate.

Special requirements of the chemical and petroleum industries, particularly for the measuring of flow of viscous liquids, may be met by a new electric meter body.[8]

A patent (United States 2,400,831) has been issued [9] for the use of frozen mercury as a material for patterns for the preparation of precision casting molds for the production of heat-resisting blades of jet aircraft engines.

Mercury consumed in the United States, 1945–46, in flasks of 76 pounds

Use	1945 [1]	1946 [2]	Use	1945 [1]	1946 [2]
Pharmaceuticals	11,166	4,093	Electrical apparatus	[3] 24,468	[3] 3,849
Dental preparations	537	1,086	Industrial and control instruments	[3] 3,776	[3] 3,960
Fulminate:			Amalgamation	205	76
Munitions	1,115	682	General laboratory	337	196
Blasting caps			Redistilled	[3] 9,712	[3] 5,572
Agriculture	2,862	3,134	Other	2,343	3,167
Antifouling paint	1,661	994		62,429	[2] 31,200
Electrolytic preparation of—					
Chlorine	597	546			
Caustic Soda					
Catalysts	3,650	3,310			

[1] Revised.
[2] The items do not quite add to the total, which has been increased to cover approximate total consumption.
[3] A partial break-down of the "redistilled" classification for 1945 showed 53 percent was for electrical apparatus and 28 percent for instruments. The war battery program increased the proportion for electrical apparatus. Data for 1946 are not completed as yet but probably will show a return to the more normal relationship of approximately half for instruments.

[7] Chemical Industries, Mercurial Controls Paper Mill Slime: Vol. 59, No. 3, September 1946, p. 500.
[8] Chemical Engineering, High-Viscosity Meter: Vol. 53, No. 8, August 1946, p. 134.
[9] Metal Industry (London), vol. 69, No. 4, July 26, 1946, p. 66.

Mercury consumed in the United States, 1940–45, by months, and 1946, by quarters, in flasks of 76 pounds

Month	1940	1941	1942	1943	1944	1945	1946
January	2,300	2,900	3,800	4,500	3,400	5,200	
February	2,000	4,700	3,000	4,700	3,700	5,100	6,800
March	1,800	4,000	3,500	4,900	3,600	6,100	
April	1,900	3,200	3,600	5,500	3,200	7,500	
May	2,200	3,500	4,200	5,600	3,100	8,900	8,100
June	2,500	3,300	3,700	4,700	3,400	8,500	
July	2,200	3,300	3,200	4,700	3,000	6,600	
August	2,100	3,600	3,700	4,900	3,900	5,300	7,400
September	2,100	3,700	4,100	4,100	3,900	3,100	
October	2,700	4,800	6,200	3,800	3,900	3,100	
November	2,900	3,900	6,200	3,900	3,900	2,500	8,900
December	2,100	3,900	4,500	3,200	3,900	2,000	
	26,800	44,800	49,700	54,500	42,900	[1] 62,429	31,200

[1] Revised; monthly items not adjusted to final total.

STOCKS

Production plus general imports of mercury exceeded consumption by more than 17,000 flasks, but visible stocks dropped substantially nonetheless. Consumers' and dealers' stocks were little changed but were actually higher at the end than at the beginning of 1946, as some consumers' metal was withdrawn into the permanent stock pile. Producers' inventories showed a small decline, but Office of Metals Reserve stocks dropped nearly 43,000 flasks. The latter change likewise involved an absorption into the permanent stock pile.

Stocks of mercury in hands of consumers and dealers, producers, and Office of Metals Reserve, 1942–46, in flasks of 76 pounds

End of year	Consumers and dealers	Producers[1]	Office of Metals Reserve	Total
1942	10,700	1,377	[2] 27,410	39,500
1943	13,200	3,457	[2] 69,852	86,500
1944	10,400	2,714	67,812	80,900
1945	17,000	3,243	63,638	83,900
1946	16,400	2,599	20,884	39,900

[1] Operators that account for roughly 95 percent of output.
[2] Total Government inventory.

PRICES

With the exception of a minor reaction in March, the price for mercury trended downward throughout 1946, a continuation of the general movement since March 1945. The ample domestic and world supplies of mercury, in contrast to the general commodity situation, has led to this weakening price structure. The average monthly price of $88 for December 1946 was the lowest on record since August 1939, the month before World War II began in Europe. The revised positions of Germany and Japan, no longer two of the chief mercury-consuming countries of the world as they were before World War II, have placed on mercury-exporting countries the burden of developing new or of expanding present markets for the metal. Surplus metal from record war production and accumulated mine stocks vie with new production for existing markets.

Average monthly prices per flask (76 pounds) of mercury at New York and London, and excess of London price over New York price, 1944–46

Month	1944			1945			1946		
	New York [1]	London [2]	Excess of London over New York	New York [1]	London [2]	Excess of London over New York	New York [1]	London [2]	Excess of London over New York
January	$151.60	$281.44	$129.84	$156.85	$281.44	$124.59	$104.81	$126.06	$21.25
February	130.00	281.44	151.44	165.55	281.44	115.89	102.73	126.06	23.33
March	130.00	281.44	151.44	162.00	281.44	119.44	103.92	126.06	22.14
April	128.20	281.44	153.24	156.84	281.44	124.60	102.46	126.05	23.59
May	115.54	281.44	165.90	153.69	281.44	127.75	101.00	126.04	25.04
June	101.69	281.44	179.75	147.73	281.44	133.71	99.40	126.05	26.65
July	100.56	281.44	180.88	140.72	281.06	140.34	98.31	126.05	27.74
August	104.04	281.44	177.40	123.20	280.88	157.68	97.56	126.05	28.49
September	104.28	281.44	177.16	95.84	280.74	184.90	96.00	126.04	30.04
October	109.20	281.44	172.24	101.39	126.01	24.62	95.19	126.00	30.81
November	116.30	281.44	165.14	106.87	126.06	19.19	89.39	100.57	11.18
December	128.88	281.44	152.56	108.00	126.05	18.05	88.12	83.61	[3] 4.51
Average	118.36	281.44	163.08	134.89	242.45	107.56	98.24	120.39	22.15

[1] Engineering and Mining Journal, New York.
[2] Mining Journal (London) prices in terms of pounds sterling are converted to American dollars by using average rates of exchange (official for January 1944 through June 1945 and free thereafter) recorded by Federal Reserve Board. Official prices were £68 10s. to £69 15s. until October 1945, when they were reduced to £30 to £31 5s; maximum prices were revoked in August 1946.
[3] New York excess.

The British Ministry of Supply revoked its maximum price order in August; but, continuing as sole importer and distributor, did not reduce the selling price. The official price was dropped £5, effective November 15, when control of imports was relinquished. By the end of the year the quoted price was £20 15s., having dropped from £31 5s. at the beginning of the year. In December the London price was below the New York price for the first month since May 1942. A New York excess is normal, however, owing to the United States tariff on mercury.

FOREIGN TRADE [10]

Imports of mercury receded sharply in 1946 from the record receipts in 1945, imports for consumption falling 80 percent. General imports remained at a very high rate in relation to prewar years, however, and probably were higher than in any other peace year except 1926 and 1927; general imports in 1946 fell short of the war years—1942, 1943, and 1945. The completion of contracts for Spanish metal to fill war battery needs and the upsurge of Italian interest in obtaining foreign credits are evident from comparison of imports for 1945 and 1946. The general import data show the changes more effectively than imports for consumption.

Of general imports of 23,062 flasks in 1946 (comparisons with 1945 in parentheses), 10,284 (none) flasks came from Italy, 6,669 (13,082) from Mexico, 5,559 (55,747) from Spain and 550 (751) from Chile; in 1945, in addition, 1,720 flasks came from Canada, 23 from Honduras and 185 from Peru. Seventy-five percent of the imports came into the country in the latter half of the year, about evenly divided between

[10] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

the third and fourth quarters. In addition to the quantities shown for 1946, over 8,000 flasks of mercury from surplus European stocks were purchased by a domestic consumer but held for reexport, not entering the United States market.

Imports for consumption, which are covered by the long-time record, were very different from general imports in 1946, amounting to only 13,894 flasks. Of the imports for consumption in 1946 (comparisons with 1945 in parentheses), 5,360 (10,853) came from Mexico, 5,038 (none) from Italy, 3,127 (55,391) from Spain, 369 (477) from Chile, and in addition in 1945, 1,720 from Canada, 153 from Peru, and 23 from Honduras.

Mercury imported for consumption in the United States, 1942–46

Country	1942		1943		1944	
	Pounds	Value	Pounds	Value	Pounds	Value
Canada	562,348	$1,337,640	1,184,211	$3,009,271	118,906	$337,177
Chile	107,091	266,920	202,148	506,710	74,627	152,309
Honduras						
Italy						
Mexico	2,288,505	5,122,516	2,238,725	5,010,038	1,288,548	2,012,873
Nicaragua	1,545	3,395				
Peru			8,132	19,934	3,944	9,397
Spain						
Total: Pounds	[1] 2,959,489	6,730,471	[1] 3,633,216	8,545,953	1,486,025	2,511,756
Flasks	[1] 38,941		[1] 47,805		19,553	

Country	1945		1946	
	Pounds	Value	Pounds	Value
Canada	130,720	$237,175	2	$6
Chile	36,285	55,995	28,064	27,978
Honduras	1,748	3,621		
Italy			382,880	325,274
Mexico	824,789	1,296,851	407,334	378,235
Nicaragua				
Peru	11,628	19,570		
Spain	4,209,720	7,386,167	237,676	201,783
Total: Pounds	5,214,890	8,999,379	1,055,956	933,276
Flasks	68,617		13,894	

[1] Includes the following quantities reexported and not separately classifiable by countries: 1942, 567,059 pounds (7,461 flasks); 1943, 1,128,727 pounds (14,852 flasks).

Imports of mercury compounds were negligible in 1946, compared with none in 1945 or 1944. Twenty-six pounds of mercuric chloride and 454 pounds of vermilion red were entered.

As usual, exports of mercury in small quantities went to a large number of countries. A total of 907 flasks was shipped from the country in 1946, only 4 percent of general imports, compared with 1,038 flasks in 1945. The chief countries of destination in 1946 (comparisons with 1945 in parentheses) were as follows: Brazil, 258 (62); Canada, 124 (26); Colombia, 86 (29); Sweden, 56 (600); Nether-

lands, 48 (13); Venezuela, 39 (33); Union of South Africa, 36 (23); Hong Kong, 25 (none); and 34 other countries, the remainder in quantities of less than 25 flasks each.

Mercury exported from the United States, 1942–46

Year	Pounds	Flasks of 76 pounds	Value	Year	Pounds	Flasks of 76 pounds	Value
1942	26,252	345	$76,448	1945	78,852	1,038	$121,713
1943	29,236	385	88,842	1946	68,932	907	113,817
1944	57,007	750	123,481				

Reexports of mercury aggregated 2,357 flasks in 1946, or 39 percent above the expanded quantity of 1,693 flasks for 1945. Reexports are items, previously imported, that are exported without change in form. Canada ranked first as a reexport destination in 1946, with 502 flasks; Brazil received 493 flasks; Sweden, 367 flasks; Switzerland, 353 flasks; Argentina, 193 flasks; China, 120 flasks; Belgium, 105 flasks; and 14 other countries the remainder in quantities of 50 flasks, or less, each.

Exports of mercury salts, separately classified beginning July 1941, were lost in a blanket classification beginning January 1, 1946. The quantities of equivalent metal represented by such salts were insignificant.

WORLD REVIEW

Supplies of mercury from a world standpoint caught up with and passed requirements for the metal by a wide margin long before a balance was reached in most commodities. Surplus war stocks and large mine stocks were held in Europe at the outset of 1946. All important mercury-producing countries, except Italy, had relatively maintained or reduced outputs in 1946, and Italian production was far below peak war rates. As a consequence, the world total in 1946 was 2 percent less than in 1945 (itself 14 percent below 1944) and was about half of the all-time high record for 1941.

Mercurio Europeo, the international mercury cartel, has been active in reestablishing itself and has appointed agencies to represent it all over the world. The agencies and areas covered by them are as follows:

Elder, Smith & Co., Ltd., 3, St. Helen's Place, London E. C. 3, England (British Empire, China, Japan, Palestine, Iraq, Iran, Trans-Jordan, Saudi Arabia, and Egypt).

Belgameric, Rue Montoyer 4, Brussels, Belg. (Belgium, Netherlands, Luxembourg, and respective colonies).

Scandinaviska Malm-Och Metallaktiebolaget, Postbox 16130, Stockholm 16, Sweden (Sweden, Norway, Denmark, and Finland).

Société Impex 9, Rue Boissy-d'Anglas, Paris 8, France (France and colonies).

"Patvag," Bahnhofstrasse, 12-Zürich, Switzerland (Switzerland, Austria, Poland, Czechoslovakia, Hungary, Balkan countries, and Turkey).

"Tecnar," San Martin 195, Buenos Aires, Argentina (South and Central America).

Chematar Inc., 40 Exchange Place, New York 5, N. Y. (Russia).

World production of mercury, 1939–46, by countries, in flasks of 34.5 kilograms (76 pounds)

[Compiled by B. B. Mitchell]

Country	1939	1940	1941	1942	1943	1944	1945	1946
Algeria	256	791	147	121	146	165	326	340
Australia:								
New South Wales		(2)	1	(2)			(1)	(1)
Queensland	3	37	34	15	15	12	3	(1)
Austria	9	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Bolivia (exports)	7				51	2	3	
Canada	6	2,024	7,057	13,630	22,240	9,682		
Chile	[3] 100	[3] 100	1,305	2,256	2,563	1,181	862	[3] 500
China	4,931	3,403	3,611	4,728	[3] 3,423	[3] 2,988	1,828	1,711
Czechoslovakia	[4] 2,669	[4] 2,582	(1)	(1)	(1)	(1)	(1)	(1)
Germany	1,218	957	899	493	(1)	(1)	(1)	(1)
Italy	67,154	91,230	94,160	75,885	[3] 60,000	[3] 35,000	[3] 40,000	49,314
Japan [5]	1,358	3,394	4,119	5,863	6,715	6,808	2,141	1,421
Korea (Chosen)	1	2	(1)	(1)	(1)	(1)	(1)	(1)
Mexico	7,376	11,653	23,137	32,443	28,321	26,063	16,443	11,661
New Zealand			73	150	93	90	30	(1)
Peru				145	326	152	209	5
Rumania				21	176	(1)	(1)	(1)
Southern Rhodesia	(2)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Spain	35,912	52,214	86,473	72,288	47,756	34,349	40,694	[3] 41,000
Tunisia	58	125	88	3	(2)			(1)
Turkey	359	500	242	176	186	97	158	
Union of South Africa		42	204	579	1,189	1,192	852	[6] 673
U. S. S. R	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
United States	18,633	37,777	44,921	50,846	51,929	37,688	30,763	25,348
Total [7]	145,000	215,000	275,000	265,000	235,000	165,000	142,000	139,000

[1] Data not yet available; estimates included in total.
[2] Production less than 1 flask.
[3] Conjectural.
[4] Slovak Metallurgical Works.
[5] Preliminary data for fiscal year ended Mar. 31 of year following that stated.
[6] January to September, inclusive.
[7] Estimated by author.

REVIEW BY COUNTRIES

Canada.—In a discussion [11] in the House of Commons, Ottawa, it was brought out that no mercury was produced in Canada in 1946, that 1,721 flasks of mercury from the Pinchi Lake mine production remained unsold as of December 31, 1946, and that 2,009 flasks of mercury were imported into Canada in 1946. Reasons for closing the mine July 1944 were given as the accumulation of stock and lack of market at what the producer considered an economic price.

Germany.—Notes on German chlorine and caustic soda practice were published in the report of this series for 1945. The data were summarized [12] in greater detail later. Another report [13] pointed out possibilities of the use of mercury in a new-type storage battery. Still another report [14] discussed mercury oxide catalyst for acetaldehyde production.

Italy.—Italy was the only important mercury-producing country to increase output appreciably in 1946; production amounted to 49,314 flasks, a gain of 23 percent over 1945. Italy was the chief mercury-producing country in the world in 1946, but the expanded

[11] Northern Miner, Canada's Mercury Position: Vol. 32, No. 50, Mar. 6, 1947, p. 19.
[12] Gardiner, William C., and others, Vertical Mercury Chloride Cells, I. G. Farbenindustrie, A. G.: Off. of Military Govt. for Germany (US) FIAT Final Rept. 817, June 15, 1946, 51 pp. (Published by U. S. Department of Commerce).
[13] Matthias, Lynn H., Survey of a New Storage Battery: Off. of Military Govt. for Germany (US) FIAT Final Rept. 670, January 7, 1946, 3 pp. (Published by U. S. Department of Commerce.)
[14] Gardiner, William C., Electrolytic Mercury Oxide at Burghausen: Off. of Military Govt. for Germany (US) FIAT Final Rept. 822, May 17, 1946, 8 pp. (Published by U. S. Department of Commerce).

output in that year was only 74 percent of the average annual rate in 1937–39, when production was high, owing largely to the civil war in Spain and doubtless in part to anticipation of the world conflict that eventuated. Production in Italy can be expanded sharply (the 1946 total was only 52 percent of the all-time peak in 1941), but present world needs cannot support a higher rate. The Idria mine in the Province of Gorizia, however, is no longer under Italian control, having been ceded to Yugoslavia. Italy obtained control of this property from Austria following World War I. The shift in control of the Idria mine reduces Italy's production potentiality by possibly 8,500 flasks annually. According to the Metal Bulletin (London) of July 9, 1946, the Italian Finance Minister reduced the special sales tax on quicksilver from 2,000 to 500 lire a flask in midyear.

Japan.—Statistics recently made available indicate that Japanese output of mercury during World War II was higher than had been generally supposed. A peak of 6,808 flasks was produced in 1944, but output dwindled to 1,421 flasks in 1946. The Reconstruction Finance Corporation announced January 24, 1947, that 100 metric tons (2,900 flasks) were expected soon from Japan for disposition by the United States Commerical Company (RFC subsidiary). Of the total, 1,800 flasks were said to be Italian mercury and 1,100 flasks Japanese metal.

Mexico.—Mercury occurrences in Mexico were described in the report of this series for 1944. The geology of the Cuarenta district was the subject of a recent report.[15] With regard to the future of the district, the authors state:

> The mercury mines of the Cuarenta district are wrecked by gophering and pillar-robbing beyond any hope of reclamation. Mining stopped in the Cuarenta mercury district in August 1943. Good ore is said to remain under water in the bottom of the Foco mine, and the lower 2 or 3 meters of much of the conglomerate is said to constitute a large tonnage of low-grade ore, but whether this ore is real or imaginary must await proof by someone willing to spend the money necessary to sample it properly.

Livingstonite, the rare antimony-mercury sulfide, is the sole primary mercury ore mineral in the Huitzuco district, Guerrero, according to McAllister and Ortiz.[16]

United Kingdom.—The British Ministry of Supply revoked its maximum price on mercury in August; but inasmuch as the Ministry continued to be the sole importer and distributor, the price continued at £30 to £31 5s. a flask, according to quantity. The price in the United Kingdom thus was $25± a flask over that in the United States, where a tariff of $19 a flask is in force. The official United Kingdom price was reduced £5 a flask, effective November 15, and the British Board of Trade relinquished control of imports (which reverted to private hands) as of the same date. Forward offerings by a leading importer were then reported on the basis of £20 15s., pending the arrival of cheaper metal from producing countries. In December, Elder, Smith & Co., Ltd., of Australia and London, was reported to have been appointed the new and sole Mercurio Europeo selling agent

[15] Gallagher, D., and Siliceo, R. P., Geology of the Cuarenta Mercury District, State of Durango, Mexico: Geol. Survey Bull. 946–F, 1946, pp. 155–168.
[16] McAllister, J. F., and Ortiz, D. H., Quicksilver-Antimony Deposits of Huitzuco, Guerrero, Mex.: Geol. Survey Bull. 946–B, 1945, pp. 49–71.

for the United Kingdom and the rest of the British Empire. Later it was learned that this company also would act for some independent Asiatic and African countries.

The new battery plant at Belfast, Ireland, mentioned in the report of this series for 1945, was said to be limiting output in 1946 almost entirely to military applications.

Yugoslavia.—According to the Metal Bulletin (London) of December 6, 1946, the Idria mine, which ceased to be a member of Mercurio Europeo on being ceded to Yugoslavia, now operates under the title Rudnik Ziveta Sreba. This mine was transferred to Italy after World War I.

Mica

By G. RICHARDS GWINN AND E. M. TUCKER

GENERAL SUMMARY

PRODUCTION of sheet and punch mica in 1946 decreased slightly from the total reported in 1945, but the output of ground mica reached an all-time high. The stimulus provided by the recent war period has increased substantially the output from South Africa and Argentina, and increased activity has also been reported in the mica fields of Tanganyika, Angola, and Kenya Colony. India and Brazil, however, are still the major mica-producing countries of the world. The output of phlogopite mica in Madagascar in 1946, as in the previous year, was low because of unsettled conditions in the labor market and fluctuations in the Metropolitan and Malagasy (Madagascan) francs.

There is a growing tendency in the foreign mica-producing countries to establish a mica-processing industry to sell the finished product, which brings a higher price than crude block or sheet. With the great wealth of manpower available and relatively low labor costs, this practice may affect the domestic processing trade. Domestic producers for the most part have returned to the prewar practice of offering only half-trim material for sale, with a consequent reduction in the value received. Muscovite sheet and film mica of certain sizes and qualities and some grades and sizes of muscovite and phlogopite splittings are included in the list of strategic minerals that must be stockpiled for national defense.

The National Bureau of Standards has developed a machine for the mechanical splitting of mica that appears to have commercial possibilities.[1] Reports on the exploration of mica deposits in Idaho,[2] New Mexico,[3] and Alabama [4] have recently been released.

The accompanying table of salient statistics summarizes domestic production and total supply of mica available in the United States for the 1942–46 period.

[1] Kessler, W. D., Mica Delamination Aided by Science: Domestic Commerce, vol. 34, No. 3, March 1946, p. 14.

[2] Reed, G. E., Exploration of the Avon Mica District, Latah County, Idaho: Bureau of Mines Rept. of Investigations 3898, 1946, 23 pp.

[3] Holmquist, R. J., Exploration of the Elk Mountain Mica Deposit San Miguel County, N. Mex.: Bureau of Mines Rept. of Investigations 3921, 1946, 7 pp.

[4] Staff of Mining Branch, Tuscaloosa Division, Mica and Beryl Examination and Exploration in Cleburne, Randolph, Clay, Coosa, Chilton, Tallapoosa, and Lee Counties, Ala.: Bureau of Mines Rept. of Investigations 3905, 1946, 119 pp.

Salient statistics of the mica industry in the United States, 1942–46

	1942	1943	1944	1945	1946
Domestic mica sold or used by producers:					
Total uncut sheet and punch:					
Pounds	2,761,844	3,448,199	1,523,313	1,298,587	1,078,867
Value	$725,030	$3,228,742	$3,262,711	$737,342	$217,955
Average per pound	$0.26	$0.94	$2.14	$0.57	$0.20
Scrap: [1]					
Short tons	43,262	46,138	51,727	[2] 41,060	53,602
Value	$671,165	$738,025	$1,089,072	[2] $812,322	$1,041,423
Average per ton	$15.51	$16.00	$21.05	[2] $19.78	$19.43
Total sheet and scrap: [1]					
Short tons	44,643	47,862	52,489	[2] 41,709	54,141
Value	$1,396,195	$3,966,767	$4,351,783	[2] $1,549,664	$1,259,378
Total ground: [1]					
Short tons	46,979	51,582	52,713	[2] 51,806	62,113
Value	$1,653,358	$1,990,144	$1,914,709	[2] $1,995,969	$2,516,018
Consumption of splittings:					
Pounds	6,636,639	8,413,362	8,816,965	7,897,402	7,815,989
Value	$2,835,421	$3,518,822	$4,657,730	$3,415,696	$4,259,478
Imports for consumption:					
Total uncut sheet and punch:					
Pounds	3,244,857	5,501,745	5,032,983	4,284,720	4,499,562
Value	$2,141,465	$6,313,900	$3,921,078	$4,125,016	$2,288,448
Scrap:					
Short tons	2,179	2,048	2,412	3,567	6,208
Value	$25,879	$27,102	$32,688	$41,410	$75,846
Total sheet and scrap:					
Short tons	3,801	4,799	4,928	5,709	8,458
Value	$2,167,344	$6,341,002	$3,953,766	$4,166,426	$2,364,294
Manufactured:					
Short tons	7,493	8,960	2,314	3,695	5,487
Value	$6,860,434	$9,513,064	$3,707,718	$2,172,333	$4,754,583
Total imports:					
Short tons	11,294	13,759	7,242	9,405	13,945
Value	$9,027,778	$14,854,066	$7,661,484	$6,338,759	$7,118,877
Exports (all classes of mica):					
Short tons	1,001	693	619	981	1,542
Value	$303,526	$653,889	$526,824	$377,473	$709,109

[1] Includes mica recovered from kaolin and mica schists as follows: 1942, 20,481 tons, $315,807; 1943, 24,113 tons, $314,851; 1944, 22,107 tons, $485,567; 1945, 15,046 tons, $324,515; and 1946, 15,197 tons, $290,540.
[2] Revised figure.

DOMESTIC PRODUCTION

Sheet Mica.—The quantity of sheet and punch mica produced in 1946 reached 1,078,867 pounds valued at $217,955, compared with 1,298,587 pounds valued at $737,342 in 1945. Although the quantity of mica produced in 1946 was only 17 percent below that reported in the previous year, the value was 70 percent less than the 1945 figure. This is attributed to revocation of the Government subsidized buying program on November 30, 1945, and the return by most of the mica producers in 1946 to half-trim preparation of sheet mica. Punch mica in 1946 accounted for 91 percent of the total sheet produced or 986,891 pounds valued at $126,039. In 1946 North Carolina supplied 34 percent of the punch, 92 percent of the sheet, and 73 percent of the scrap mica produced in the United States.

Production statistics on mica are obtained by the Bureau of Mines from schedules sent to individual miners. These totals are checked against similar schedules obtained from purchasers of mica. In 1946, however, many producers failed to report, and the Bureau of Mines was obliged to depend largely on reports from purchasers.

Mica sold or used by producers in the United States, 1935–39 (average) and 1940–46

Year	Sheet mica						Scrap mica and mica recovered from kaolin and schists		Total	
	Uncut punch and circle mica		Uncut mica larger than punch and circle		Total uncut sheet mica [1]					
	Pounds	Value	Pounds	Value	Pounds	Value	Short tons	Value	Short tons	Value
1935–39 (average)	888,313	$46,408	252,411	$139,306	1,140,724	$185,714	21,986	$285,512	22,557	$471,226
1940	1,405,305	116,087	220,132	175,598	1,625,437	291,685	22,386	314,565	23,199	606,250
1941	2,342,237	206,947	324,216	359,911	2,666,453	566,858	32,500	442,789	33,833	1,009,647
1942	2,425,645	282,900	336,199	442,130	2,761,844	725,030	43,262	671,165	44,643	1,396,195
1943	2,691,083	473,955	757,116	2,754,787	3,448,199	3,228,742	46,138	738,025	47,862	3,966,767
1944	835,402	147,635	687,911	3,115,076	1,523,313	3,262,711	51,727	1,089,072	52,489	4,351,783
1945:										
Connecticut	60,823	3,246	1,009	6,879	61,832	10,125	70	1,752	101	11,877
Idaho	33,948	11,510	14,070	99,498	48,018	111,008	199	3,178	223	114,186
New Hampshire	519,343	53,593	13,601	91,354	532,944	144,947	442	11,206	708	156,153
North Carolina	491,428	82,292	72,562	160,766	563,990	243,058	[2] 30,682	[2] 709,334	[2] 30,964	[2] 952,392
South Dakota	32,506	9,727	24,064	168,969	56,570	178,696	1,192	21,534	1,220	200,230
Other States [3]	28,810	5,748	6,423	43,760	35,233	49,508	8,475	65,318	8,493	114,826
	1,166,858	166,116	131,729	571,226	1,298,587	737,342	[2] 41,060	[2] 812,322	[2] 41,709	[2] 1,549,664
1946:										
North Carolina	339,997	54,684	84,794	80,821	424,791	135,505	39,100	887,901	39,312	1,023,406
South Dakota	13,884	2,148	3,516	6,284	17,400	8,432	2,806	63,692	2,815	72,124
Other States [4]	633,010	69,207	3,666	4,811	636,676	74,018	11,696	89,830	12,014	163,848
	986,891	126,039	91,976	91,916	1,078,867	217,955	53,602	1,041,423	54,141	1,259,378

[1] Includes small quantities of splittings in certain years.
[2] Revised.
[3] Includes Alabama, Arizona, California, Colorado, Georgia, Maine, Massachusetts, Nevada, New Mexico, Pennsylvania, South Carolina, Virginia, and Wyoming.
[4] Includes Alabama, California, Colorado, Connecticut, Georgia, Maine, New Hampshire, New York, South Carolina, and Virginia.

Scrap Mica.—Production of scrap mica in 1946 reached 53,602 short tons valued at $1,041,423 compared with 41,060 tons valued at $812,322 in 1945. In addition to mine scrap, these figures include 15,197 tons valued at $290,540 of mica reclaimed as a byproduct of kaolin washing and feldspar flotation operations, and by milling mica schists. Feldspar flotation is a new source of reclaimed mica. At present the only producer is the Carolina Minerals Co., Kona, N. C.

Despite the large volume of domestic scrap mica produced, a shortage developed, and mica grinders had to import large quantities of scrap from Angola, Tanganyika, Portuguese East Africa, India, Peru, Canada, and Mexico.

The production of scrap and reclaimed mica for the 1941–46 period and the 1935–39 average are given in an accompanying table.

Scrap and reclaimed mica sold or used by producers in the United States, 1935–39 (average) and 1941–46

Year	Scrap		Reclaimed		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1935–39 (average)	13,582	$168,688	8,404	$116,824	21,986	$285,512
1941	16,917	257,303	15,583	185,486	32,500	442,789
1942	22,781	355,358	20,481	315,807	43,262	671,165
1943	22,025	423,174	24,113	314,851	46,138	738,025
1944	29,620	603,505	22,107	485,567	51,727	1,089,072
1945 [1]	26,014	487,807	15,046	324,515	41,060	812,322
1946	38,405	750,883	15,197	290,540	53,602	1,041,423

[1] Revised figures.

Ground Mica.—The output of ground mica in 1946 reached an all-time high of 62,113 short tons valued at $2,516,018, an increase of 20 percent over the 51,806 tons valued at $1,995,969 reported in 1945 and 18 percent above the previous record year of 1944.

The roofing industry in 1946, as in previous years, was the largest user of ground mica. The paint industry consumed substantial quantities of dry ground mica as well as the major part of the wet ground material. As shown in an accompanying table, the roofing

Ground mica (including mica from kaolin and schists) sold by producers in the United States to various industries, 1945–46

Industry	1945			1946		
	Quantity		Value	Quantity		Value
	Short tons	Percent of total		Short tons	Percent of total	
Roofing	[1] 28,407	[1] 55	[1] $711,175	30,102	48	$791,639
Wallpaper	1,911	4	139,719	2,827	5	240,786
Rubber	3,715	7	241,657	4,951	8	381,231
Paint	7,570	[1] 14	382,992	14,452	23	638,598
Plastics	990	[1] 2	83,941	321	1	33,066
Miscellaneous [2]	9,213	[1] 18	436,485	9,460	15	430,698
	[1] 51,806	100	[1] 1,995,969	62,113	100	2,516,018

[1] Revised.
[2] Includes mica used for molded electric insulation, house insulation, Christmas-tree snow, manufacture of axle greases and oil, annealing, pipe-line enamel, textiles, oil-well drilling, welding, and other purposes.

and paint industries accounted for 72 percent of the quantity and 57 percent of the value of the 1946 output of ground mica. This high percentage is attributed to increased requirements for roofing and paint by the construction industries.

The history of the scrap and ground mica industries for the 1923–46 period is indicated in figure 1.

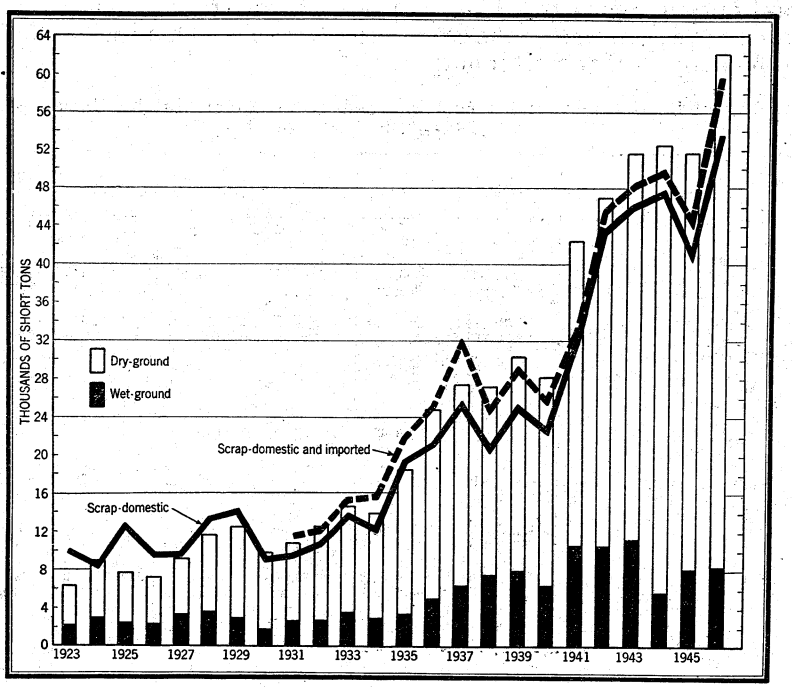

FIGURE 1.—Scrap and ground mica sold in the United States 1923–46.

Ground mica (including mica from kaolin and schists) sold by producers in the United States, 1942–46, by methods of grinding

Year	Dry-ground		Wet-ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1942	36,369	$805,163	10,610	$848,195	46,979	$1,653,358
1943	40,256	1,027,781	11,326	962,363	51,582	1,990,144
1944	47,023	1,382,147	5,690	532,562	52,713	1,914,709
1945 [1]	43,686	1,243,075	8,120	752,894	51,806	1,995,969
1946	53,908	1,582,974	8,205	933,044	62,113	2,516,018

[1] Revised figures.

An improvement in the manufacture of Mycalex products was patented by Guenther Bueckner (U. S. Patent 2,400,337, May 14, 1946) and assigned to the General Electric Co. Faster and improved methods of producing molded mica parts by the utilization of silicone oil as a mold-release agent have also recently been reported by the General Electric Co.[5]

[5] Chemical and Engineering News, Silicone Oil in Molding: Vol. 24, No. 18, Sept. 25, 1946, p. 2532.

Production of sheet, punch, and scrap mica in the United States for the 1942–46 period, by districts,[6] is given in the accompanying table. Because of the small number of miners reporting, figures for some classes of mica in several districts cannot be released. The Southeastern district in 1946 again was the principal producer of sheet and scrap mica contributing, respectively, 93 and 76 percent of the total output reported. The Northeastern district in 1946, as in the previous year, produced the largest quantity of punch mica, accounting for 62 percent of the total output.

Sheet, punch, and scrap mica sold or used by producers in the United States, 1942–46, by districts

	1942	1943	1944	1945	1946	Total 1942–46
Sheet:						
Southeastern:						
Pounds	220,108	403,257	376,757	78,510	85,525	1,164,157
Value	$355,149	$1,804,247	$1,642,278	$201,595	$81,863	$4,085,132
Northeastern:						
Pounds	78,108	259,584	189,492	14,624	2,901	544,709
Value	$49,411	$511,633	$745,157	$98,347	$3,726	$1,408,274
Southwestern:						
Pounds	2,663	4,112	1,965	390	(1)	[2] 9,130
Value	$1,726	$18,433	$11,784	$2,660	(1)	[2] $34,603
Northwestern:						
Pounds	5	5,228	38,963	14,141	----	58,337
Value	$2	$25,939	$247,071	$99,655	----	$372,667
Black Hills:						
Pounds	35,315	84,935	80,734	24,064	3,516	228,564
Value	$35,842	$394,535	$468,786	$168,969	$6,284	$1,074,416
Punch:						
Southeastern:						
Pounds	1,563,538	1,729,573	514,698	520,118	356,797	4,684,724
Value	$200,326	$203,358	$72,768	$87,970	$57,720	$622,142
Northeastern:						
Pounds	489,436	709,740	240,546	580,166	615,972	2,635,860
Value	$41,331	$216,160	$67,822	$56,839	$66,121	$448,273
Southwestern:						
Pounds	8,762	2,627	4,375	----	(1)	[2] 15,764
Value	$1,398	$1,596	$1,750	----	(1)	[2] $4,744
Northwestern:						
Pounds	----	654	10,134	34,068	----	44,856
Value	----	$167	$2,055	$11,580	----	$13,802
Black Hills:						
Pounds	363,909	248,489	65,649	32,506	13,884	724,437
Value	$39,845	$52,674	$3,240	$9,727	$2,148	$107,634
Scrap:						
Southeastern:						
Short tons	30,400	33,317	37,161	[3] 31,960	40,820	173,658
Value	$545,329	$589,485	$899,902	[3] $933,264	$931,560	$3,899,540
Northeastern:						
Short tons	864	1,782	3,114	547	182	6,489
Value	$17,473	$43,550	$74,200	$13,797	$1,311	$150,331
Southwestern:						
Short tons	9,453	8,730	8,456	7,082	9,794	43,515
Value	$63,784	$61,372	$55,420	$39,749	$44,860	$265,185
Northwestern:						
Short tons	----	75	438	279	----	792
Value	----	$854	$8,145	$3,978	----	$12,977
Black Hills:						
Short tons	2,545	2,234	2,558	1,192	2,806	11,335
Value	$44,579	$42,764	$51,405	$21,534	$63,692	$223,974

[1] Data not available for publication.
[2] Figures for 1942–45 inclusive. Data for 1946 not available for publication.
[3] Revised figure.

CONSUMPTION

The decline in consumption of block and sheet mica which began in 1945 continued through 1946. The decrease is more apparent in 1946 because, although demands for the better grades of sheet mica

[6] Bureau of Mines Minerals Yearbook, 1945, p. 1502.

were reduced with the cessation of hostilities in August 1945, Government contracts in some instances continued through November of that year. The expanded use of substitutes and alternate materials for mica are also partly responsible for the decline. During 1946 the demand was largely for the lower grades of sheet mica for use in home appliances, such as toasters, waffle irons, hot plates, and similar products for civilian consumption that were not manufactured during the recent war period. Most of the domestic sheet produced was prepared as half trim suitable only for use in these products. Imports of the lower grades of sheet increased sharply in 1946 while the better grades declined.

Figure 2 summarizes graphically the situation with respect to imports of block mica and splittings and domestic production of sheet and punch.

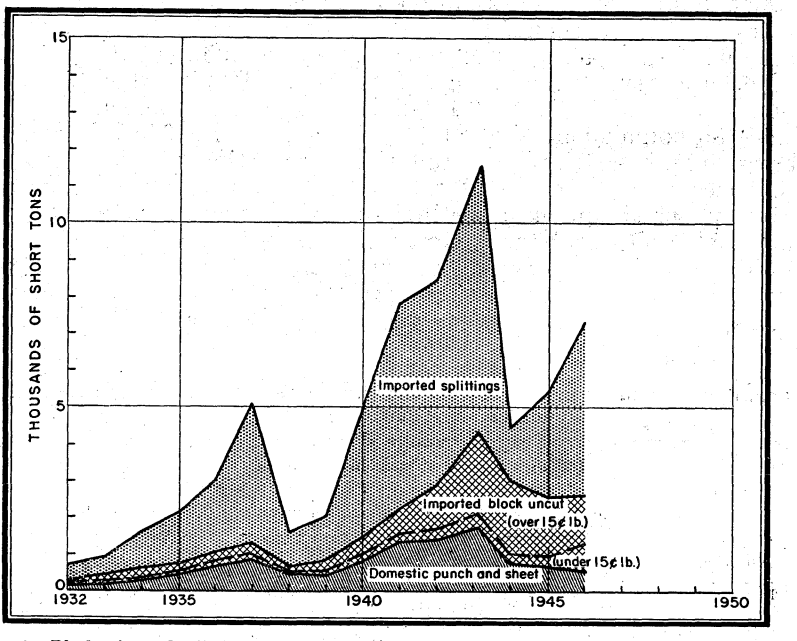

FIGURE 2.—Block mica and splittings imported for consumption in the United States and sales of domestic sheet and punch mica, 1932–46.

A summary of domestic production of sheet and punch mica and the apparent consumption of sheet, punch, and splittings for the 1935–46 period are given in an accompanying table.

Domestic production for the 1935–39 period averaged 1,140,724 pounds annually and yearly consumption about 5,037,000 pounds. Therefore, our self-sufficiency percentage was about 23 during that period. Comparable figures for the 1942–46 period are 2,022,162 pounds of domestically produced punch and sheet and 14,392,701 pounds consumed yearly, or a self-sufficiency of about 14 percent. Figures for the latter period reflect the inadequacy of domestic pro-

duction during the war years, even with premium payments, and our continued dependence on imports for the major part of our supplies.

Production of sheet and punch mica and apparent consumption of sheet and punch mica and mica splittings in the United States, 1935–46, in pounds

Year	Production	Apparent consumption	Year	Production	Apparent consumption [1]
1935	936,633	4,123,659	1941	2,666,453	12,040,476
1936	1,319,233	5,721,685	1942	2,761,844	12,888,273
1937	1,694,538	7,160,616	1943	3,448,199	17,296,196
1938	939,507	3,029,447	1944	1,523,313	15,185,998
1939	813,708	5,147,448	1945	1,298,587	13,310,700
1940	1,625,437	8,093,174	1946	1,078,867	13,282,337

[1] Revised figures.

Mica Splittings.—Consumption of mica splittings in the United States in 1946 reached 7,815,989 pounds valued at $4,259,478 compared with 7,897,402 pounds valued at $3,415,696 in 1945.

Stocks of splittings on December 31, 1946, reached 6,588,932 pounds valued at $3,615,731, an increase of 115 percent over the 3,064,589 pounds valued at $1,391,617 reported in 1945. Part of the change may be attributed to the lifting of wartime restrictions on the purchases of splittings and the subsequent increase in stocks by industry, which under peacetime conditions maintains from 3 to 9 months' supplies on hand. Government stocks remaining at the end of 1945 have become part of the stock pile for national defense and thus are out of the commercial market. Consumption and stocks of mica splittings for the 1942–46 period are shown in an accompanying table.

Consumption and stocks of mica splittings in the United States, 1942–46, by sources, as reported by consumers

Year	Indian		Canadian		Madagascan		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Consumption:								
1942	5,998,614	$2,415,709	117,295	$79,752	520,730	$339,960	6,636,639	$2,835,421
1943	7,649,596	3,054,995	344,966	172,674	337,099	233,788	[1] 8,413,362	[1] 3,518,822
1944	7,708,253	4,002,010	601,661	324,631	371,972	251,945	[2] 8,816,965	[2] 4,657,730
1945	7,085,316	2,970,013	321,216	163,658	324,383	188,530	[3] 7,897,402	[3] 3,415,696
1946	7,243,835	3,939,595	292,212	152,969	217,309	130,040	[4] 7,815,989	[4] 4,259,478
Stocks in consumers' hands Dec. 31:								
1942	8,202,240	3,367,788	257,591	178,082	321,529	201,274	8,781,360	3,747,144
1943	4,031,849	1,708,096	138,564	85,893	215,639	139,797	[1] 4,517,211	[1] 2,032,758
1944	3,578,885	1,749,011	141,427	95,850	184,970	121,307	[2] 3,994,977	[2] 2,025,165
1945	2,684,848	1,145,176	143,102	91,115	193,763	130,661	[3] 3,064,589	[3] 1,391,617
1946	5,727,615	3,039,429	275,685	166,786	535,185	378,174	[4] 6,588,932	[4] 3,615,731

[1] Consumption includes 26,510 pounds of domestic splittings and 55,191 pounds of Mexican splittings, valued at $11,308 and $46,057, respectively; stocks include 2,200 pounds of domestic splittings and 128,959 pounds of Mexican splittings, valued at $1,009 and $97,963, respectively.

[2] Consumption includes 58,350 pounds of domestic and 76,729 pounds of Mexican splittings, valued at $23,862 and $55,282, respectively; stocks include 3,694 pounds of domestic and 86,001 pounds of Mexican, valued at $1,365 and $57,632, respectively.

[3] Consumption includes 94,716 pounds of domestic and 71,771 pounds of Mexican splittings, valued at $46,731 and $46,764, respectively; stocks include 7,000 pounds of domestic and 35,876 pounds of Mexican, valued at $3,430 and $21,235, respectively.

[4] Consumption includes 7,220 pounds of domestic and 55,413 pounds of Mexican splittings, valued at $1,651 and $35,223, respectively; stocks include 4,541 pounds of domestic and 45,906 pounds of Mexican, valued at $1,390 and $29,952, respectively.

Muscovite splittings in 1946, for the second straight year, made up the bulk of the combined stocks, accounting for 87 percent of the total. This is attributed largely to wider use of muscovite splittings, reduction in output from the Madagascar mines, and closing of the Mexican phlogopite splittings industry. Statistics on the consumption of splittings on a quarterly basis, by kind and size, are no longer available.

Built-Up Mica.—Consumption of built-up mica products in 1946 reached 6,486,555 pounds valued at $10,285,862, a figure 10 percent below the 7,194,909 pounds valued at $9,846,719 reported in 1945. The downward trend that began in 1945 thus continued through 1946. The decline is attributed to the increasing use of substitute and alternate material for mica, the decrease in domestic production of large-size low-quality sheet, and the continued shortage of wire, steel, and other necessary components of electrical appliances.

Built-up mica produced in the United States, 1944–46, by kinds of product [1]

Product	1944		1945		1946	
	Pounds	Value	Pounds	Value	Pounds	Value
Molding plate	1,792,052	$1,816,920	2,015,993	$2,096,267	1,742,835	$2,061,588
Segment plate	2,521,527	3,073,074	2,441,076	3,074,435	1,860,173	2,460,860
Heater plate	364,773	372,683	390,598	716,903	685,580	1,283,908
Flexible (cold)	817,255	1,004,719	775,342	955,126	553,274	746,600
All other (tape, etc.)	1,942,642	3,876,477	1,571,900	3,003,988	1,644,693	3,732,906
Total	7,438,249	10,143,873	7,194,909	9,846,719	6,486,555	10,285,862

[1] Partly estimated.

PRICES

Prices for domestic sheet and punch mica in 1946 were based largely on negotiation between buyer and seller. Trade-journal price quotations shown in the accompanying table therefore are nominal. Although 1946 prices were substantially less than the premium prices paid during the recent war period, they were considerably higher than those reported for the prewar year 1939.

Prices for scrap mica in 1946 ranged from $15 to $17.50 per short ton f. o. b. mine in the Western States and $15 to $25 per ton in the

Trade-journal quotations and average sales value of domestic uncut sheet mica per pound in 1946

Size	Trade-journal quotations [1] Nov. 28, 1946	Average value [2]	
		Clear	Stained or spotted
Punch	$0.22	$0.13	$0.14
1½ by 2 inches	1.10	.96	.54
2 by 2 inches	1.60	1.47	.86
2 by 3 inches	2.10	2.00	1.68
3 by 3 inches	2.75	2.61	1.90
3 by 4 inches	3.50	3.00	2.80
3 by 5 inches	4.00	3.71	3.01
4 by 6 inches	5.00	4.48	4.03
6 by 8 inches	----------	5.67	5.08
8 by 10 inches	----------	8.15	----------

[1] E&MJ Metal and Mineral Markets quotations f. o. b. North Carolina.
[2] Calculated from sales by domestic producers as reported to the Bureau of Mines.

East. Prices on imported scrap, as reported by the mica grinders, ranged from $13 to $34 per ton. Prices for ground mica as quoted in the Oil, Paint and Drug Reporter were as follows: Dry-ground, per short ton 100 mesh f. o. b. mill in carlots $47.50, less than carlots $51 per ton, roofing grade 20 to 80 mesh $50 per ton; wet ground freight allowed, $100 to $125 per short ton in carlots and $110 to $140 per ton less than carlots, depending on mesh sizes.

MICA SUBSTITUTES

A synthetic resin having the trade name "Luvican" was produced by the Germans as a substitute for mica during the recent war period. Luvican is similar to the product marketed in the United States as Polectron. The German product was used primarily for high-frequency insulation and its electrical properties are comparable to polystyrene. It was only satisfactory for a few special purposes because of its brittleness. Peak production was approximately 5 tons per month.[7] Two investigators in the Netherlands have recently published a report on a product called "Scale Glass," which may be used as an alternate material for mica in radio tubes.[8]

The German research on synthetic mica which started during World War I had progressed to such a stage at the end of World War II that it should be possible to produce synthetically condenser-grade mica at a cost about 10 times that of imported natural mica.[9]

FOREIGN TRADE[10]

Imports.—In 1946 imports of all kinds of mica totaled 13,945 short tons valued at $7,118,877 compared with 9,405 tons valued at $6,338,759 in 1945, an increase of 48 percent in quantity and 12 percent in value. The increase in quantity was largely in the relatively low-cost items, scrap mica (waste and scrap) and low-grade block (other, valued not above 15 cents per pound), which increased respectively 74 and 157 percent. Imports of the better grades of block mica (valued above 15 cents per pound) were 17 percent lower than that reported in 1945. In 1946, as in the previous year, the United States imported larger quantities of block mica from Brazil than from India. Imports from Brazil and Mexico are complicated because of the circuitous route followed by the mica received. Although Brazil now has a domestic mica-splitting industry, most of the splittings exported to the United States represent block mica mined in Brazil, shipped to India for splitting, returned to Brazil, and then reexported as Brazilian splittings. Mica mining in Mexico ceased near the end of 1945, and the films and mica cut and stamped to dimensions received from that country in 1946 represent almost entirely mica purchased by United States companies in South America, brought to New York, reshipped to Mexico for preparation, and then reimported by the same companies. Further details on imports, by kinds and sources, may be found in the accompanying tables.

[7] Kline, G. M., Polyvinyl Carbazole in Germany: Modern Plastics, vol. 24, No. 3, March 1946, p. 157.
[8] Stevens, J. M., Scale Glass as a Substitute for Mica: Glass Industry, vol. 27, No. 12, December 1946, pp. 607-608.
[9] Tyler, Paul M., Synthetic Mica Research: Off. of Military Govt. for Germany (US), FIAT Final Rept. 746, Apr. 23, 1946, 20 pages.
[10] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Mica imported for consumption in the United States in 1946, by kinds and by countries

Country	Unmanufactured									
	Waste and scrap, valued not more than 5 cents per pound				Untrimmed phlogopite mica from which no rectangular piece exceeding in size 1 inch by 2 inches may be cut (duty 10 percent)		Other			
	Phlogopite (duty 15 percent)		Other duty (25 percent percent)				Valued not above 15 cents per pound n. e. s. (duty 4 cents per pound)		Valued above 15 cents per pound (duty 4 cents per pound+25 percent)	
	Pounds	Value	Pounds	Value	Pound	Value	Pounds	Value	Pounds	Value
Argentina							286,371	$34,591	452,762	$285,433
Brazil							891,299	117,295	1,291,824	916,073
British East Africa			921,198	$4,217						
Canada	3,925,480	$30,839	300	4	341,866	$56,951	310,472	30,122	3,943	14,481
Colombia									211	202
Guatemala							2,235	242	5,701	2,389
India			4,553,517	21,505			5,000	706	868,201	800,411
Madagascar									8,153	11,413
Mexico	155,691	1,090	4,354	34						
Peru			339,366	1,965			9,500	961	17,384	5,455
Portuguese Guinea and Angola			3,973	19					4,539	10,948
Southern Rhodesia									101	775
Union of South Africa			2,511,208	16,173						
Total: 1946	4,081,171	31,929	8,333,916	43,917	341,866	56,951	1,504,877	183,917	2,652,819	2,047,580
1945	5,198,323	29,078	1,935,636	12,332	489,411	56,972	584,571	56,669	3,210,738	4,011,375

Country	Manufactured—Films and splittings							
	Not cut or stamped to dimensions				Cut or stamped to dimensions (duty 45 percent)		Total films and splittings	
	Not above 12 ten-thousandths of an inch in thickness (duty 25 percent)		Over 12 ten-thousandths of an inch in thickness (duty 40 percent)					
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Brazil	4,253	$3,119	18,022	$12,245			22,275	$15,364
Canada	220	203					220	203
Guatemala	197	44					197	44
India	8,835,117	3,657,695	373,311	508,315	8,198	$20,649	9,216,626	4,186,659
Madagascar	538,060	246,263					538,060	246,263
Mexico			12,733	46,011	2,464	31,302	15,197	77,313
Total: 1946	9,377,847	3,907,324	404,066	566,571	10,662	51,951	9,792,575	4,525,846
1945	5,713,005	1,581,570	1,276,026	495,664	10,396	74,008	6,999,427	2,151,242

Country	Manufactured—cut or stamped to dimensions, shape, or form (duty 40 percent)		Manufactured—Other					
			Mica plates and built-up mica (duty 40 percent)		All mica manufactures of which mica is the component material of chief value		Ground or pulverized (duty 15 percent)	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Brazil	1,312	$807						
Canada	350	615					806,740	$23,525
Denmark					30	$11		
India	370,283	196,430	1,000	$430	800	1,277		
United Kingdom	107	5,639					51	3
Total: 1946	372,052	203,491	1,000	430	830	1,288	806,791	23,528
1945	6,470	5,601	1,771	3,627	319	821	382,466	11,042

Exports.—Exports of mica and mica products in 1946 totaled 1,542 short tons valued at $709,109, an increase of 57 percent in quantity and 88 percent in value over the 981 tons valued at $377,473 reported in 1945. The largest volume change was in ground mica. Canada, Belgium and Luxembourg, and the Union of South Africa were the chief foreign destinations. "Other manufactured products" accounted for the largest increase in value, and Italy, Canada, Venezuela, and Mexico provided the chief markets. Details of exports appear in the following table.

Mica and manufactures of mica exported from the United States in 1946, by countries

Country	Unmanufactured		Manufactured			
			Ground or pulverized		Other	
	Pounds	Value	Pounds	Value	Pounds	Value
North America:						
Canada	213,497	$2,282	1,262,555	$57,483	101,916	$213,329
Cuba	1,000	80	20,325	553	3,884	11,874
El Salvador			530	367	1,120	461
Mexico	27,623	10,445	18,292	1,564	22,885	24,164
Panama, Republic of			20,260	498	44	165
Other North America			43	38	1,949	6,079
South America:						
Argentina	10,000	526	102,370	3,241	986	1,947
Brazil			35,600	1,376	13,533	24,286
Chile			2,000	105	2,882	6,789
Colombia			981	210	1,184	1,626
Peru			25,900	599	1,246	2,257
Uruguay			4,000	200	752	1,159
Venezuela	10,000	346			48,877	4,040
Other South America					670	1,957
Europe:						
Belgium and Luxembourg			346,640	15,579	12,449	12,297
France	896	513			8,686	16,109
Italy					213,734	169,684
Netherlands			2,200	54	75	207
Portugal			1,000	53	333	929
Spain			48,550	2,362	1,386	3,274
Sweden			20,019	2,675	6,561	12,175
Switzerland			5,150	272	1,192	2,642
U. S. S. R.					13,712	14,343
United Kingdom			20,000	1,555	2,243	4,259
Other Europe					4,163	7,244
Asia:						
China					4,840	16,962
India	31,995	2,558	86,000	2,451	698	702
Netherlands Indies			11,700	414	50	76
Philippines, Republic of					1,323	7,089
Other Asia					964	3,156
Africa:						
Algeria					1,899	3,211
Belgian Congo	70	43			2,730	3,000
Madagascar			2,200	170		
Union of South Africa			262,070	9,713	5,428	10,152
Other Africa					1,245	1,696
Oceania:						
Australia			5,000	288	25	104
Other Oceania					299	1,052
Total: 1946	295,081	16,793	2,303,385	101,820	485,963	590,496
1945	285,035	14,844	1,498,004	60,316	178,569	302,313

WORLD PRODUCTION

Information on world production has increased substantially in the past 2 years, and figures on the major producing countries are now available, as shown in the accompanying table.

World production of mica, 1940–46, in metric tons [1]

[Compiled by P. Roberts]

Country [1]	1940	1941	1942	1943	1944	1945	1946
North America:							
Canada (sales)	819	1,582	2,731	3,651	3,032	3,195	2,051
Guatemala			[2] 3	5	1	[3] 1	[3] 4
Mexico	[2] 39	[2] 36	44	104	[3] 111	[2] 409	[2] 81
United States (sold or used by producers) [4]	21,046	30,693	40,499	43,419	47,617	37,838	49,116
South America:							
Argentina	442	540	625	402	594	(5)	(5)
Bolivia (exports)	1	3	3	2	2		
Brazil (exports)	1,117	867	866	796	941	984	1,148
Peru	4	8	5	9	113	491	207
Uruguay					[3]		6
Europe:							
Italy	34	304			(5)	(5)	(5)
Norway	33	68	1,391	981	[2] 724	[3] 564	[2] 224
Portugal		(5)	(5)	219	[6] 1,200	(5)	(5)
Rumania	174	126	116	628	(5)	(5)	(5)
Spain	20	215	334	387	239	18	11
Sweden	91	127	494	327	335	126	(5)
Asia:							
Ceylon	[3] 2	(7)		2	2	1	(7)
India (exports)	8,654	10,584	8,729	10,242	3,670	4,859	(5)
Korea (Chosen)	80	90	111	146	422	(5)	(5)
Africa:							
British East Africa:							
Kenya					(7)	(5)	(5)
Tanganyika	9	4	12	41	[2] 128	[2] 250	[2] 342
Uganda					12	5	(7)
Eritrea	7				(5)		(5)
Ethiopia	2	1	(5)	(5)	(5)	(5)	(5)
Madagascar	531	479	320	343	493	620	[2] 683
Portuguese East Africa	(5)		1	(5)	4	2	2
Portuguese West Africa	2	1	(7)	1	4	20	6
Rhodesia:							
Northern	2	(7)	4	10	16	7	(7)
Southern	6	9	14	54	250	196	335
Union of South Africa	1,252	1,076	1,265	1,274	1,127	1,131	1,785
Oceania:							
Australia	103	124	206	88	146	134	23
New Zealand		(5)	(5)	(7)	(7)	(7)	
Total [8]	34,500	47,000	58,000	63,100	61,700	52,000	64,200

[1] In addition to the countries listed mica is also produced in China, Colombia, and U. S. S. R., but data on production are not available.
[2] Exports.
[3] Imports into United States.
[4] Includes following quantities recovered from kaolin and schists—1940: 8,776 tons; 1941: 14,137 tons; 1942: 18,580 tons; 1943: 21,875 tons; 1944: 20,055 tons; 1945: 13,649 tons; 1946: 13,786 tons.
[5] Data not available.
[6] Estimate.
[7] Less than 1 ton.
[8] Estimated by author of chapter; excludes countries listed in footnote 1.

Australia.—It is reported that the mica industry in Australia will remain under Government control through 1947. During the recent war period mica deposits were developed in Queensland, New South Wales, South Australia, Western Australia, and the Northern Territory. Most of the production, however, has come from the Northern Territory. A few tons of phlogopite mica were recovered from a deposit at Strangeways Range, about 30 miles northeast of Alice Springs, Northern Territory. Damourite, a fine-grained hydrous mica, is recovered from a deposit of china clay in South Australia and marketed as ground mica. The mica section of Mineral Resources of Australia Summary Report 4 has recently been reviewed by the Bureau of Mines.[11]

[11] Bureau of Mines, Mineral Trade Notes: Vol. 22, No. 1, January 1946, pp. 36–46.

Brazil.—It is reported that 1,148 metric tons of mica valued at 26,732,000 cruzeiros (about $1,336,600) were shipped from Brazil in 1946. It is believed that the annual output of the better grades of block mica, in the next few years, will be greater than that reported before World War II but much less than during the war.

Canada.—The bulk of the mica produced in Canada in 1946 was phlogopite. Muscovite sheet mica recovered during the recent war years was a relatively high-cost product which, it is believed, will not continue in production under peacetime conditions. Large quantities of phlogopite scrap were exported to mica grinders and built-up-mica manufacturers in the United States. A review of the Canadian mica industry's contribution to World War II and prospects for the future has recently been published.[12]

India.—The production of mica in India in 1946 was curtailed by unsettled political and labor conditions. The industry was also concerned about the proposed manufacture of synthetic mica and the disposal of surplus stocks of mica in Great Britain. An agreement was reached by the Indian and United Kingdom Governments whereby stocks of block and film mica of grades 4 and larger will be marketed over a period of 5 years and grades 5 and smaller block and film, stained and lower, and loose splittings over a 10-year period. Sales of this stock will be through normal trade channels by Mica Distributors, Ltd., which will act as the Government's agent. One outcome of the Report of the Mica Inquiry Committee, 1944–45, in India was the Mica Mines Labor Welfare Fund Act, 1946, passed April 1, effective July 26. The act provided for a cess or tax on all mica, in whatever state, exported from British India at rates not exceeding 6¼ percent ad valorem. The money collected is to be applied by the Central Government to a fund for financing activities to promote the welfare of mica miners. The rate fixed was 2½ percent.

Madagascar.—The mica industry in Madagascar in 1946 was hampered by the unstable condition of the French franc and by labor troubles. In January 1946 the Minister of the Colonies set new prices for block mica which were, respectively, 25 and 35 percent higher for ordinary block and splitting mica, and spark-plug quality, than that paid by the United States Commercial Company during the recent war period. Consumers refused to pay the new prices, and later in the year prices were reduced. However, as the Madagascar exporters were paid in Metropolitan French francs, which were devalued below the Malagasy (Madagascan) franc, they refused to quote a firm price for phlogopite mica. Thus sales fell off and many of the mica mines closed.

[12] Spence, H. S., Mica as a Critical War Mineral: Canadian Min. Jour., vol. 67, No. 6, 1946, June pp. 611–617, and No. 7, July pp. 710–717.

Molybdenum

By EDWIN K. JENCKES

GENERAL SUMMARY

THE progressive decrease in the domestic production of Molybdenite concentrates since 1943 continued for the third successive year in 1946. Measured in terms of molybdenum contained, the out-turn was 18,218,000 pounds—59 percent of that in the previous year and 30 percent of the all-time high in 1943. Consumption of concentrates, which increased slightly in 1945 as compared to 1944, declined markedly to 14,994,000 pounds in 1946, a drop to 46 percent compared with 1945. Stocks in the hands of producers and consumers on December 31, 1946, were 114 percent of those on hand at the close of 1945.

Imports (276,475 pounds of molybdenum contained) were 42 percent of the quantity brought into the country in 1945 and were, with the exception of 10 pounds from Mexico, entirely from Chile. The importations from Canada for refining and reexport to that country (noted in the 1945 chapter of this series) were entirely absent in 1946, as were importations from Peru.

The predominant use for molybdenum is as an additive to alloy steel, although the relative proportion of molybdenum entering into other uses is increasing.

Salient statistics of the molybdenum industry in the United States, 1942–46, in thousands of pounds of molybdenum contained in ore and concentrates

	1942	1943	1944	1945	1946
Production	56,942	61,667	38,679	30,802	18,218
Imports for consumption	756	1,789	3,499	665	276
Shipments (including exports)	66,437	53,955	39,423	32,524	16,304
Consumption	56,388	49,891	31,520	32,696	14,994
Stocks (producers' and consumers') Dec. 31	12,540	17,993	19,335	16,899	19,255

GOVERNMENT REGULATIONS

Civilian Production Administration.—Order M–21 (Minerals Yearbook, 1945, p. 638) authorizing CPA to exercise controls over alloy steel and ferro-alloying materials, continued in force during 1946, but no active controls were instituted.

Office of Price Administration.—Amendment 26 to supplementary Order 129, issued and effective June 12, 1946, suspended price controls under Maximum Price Regulation 489, covering tungsten, molyb-

denum, cobalt, and vanadium. Effective November 10, 1946, supplementary Order 193 was issued, exempting from price controls all commodities except sugar and rice.

DOMESTIC PRODUCTION

The total production of molybdenum concentrates in 1946 was 18,218,000 pounds (contained molybdenum). Stocks in the hands of producers and consumers on December 31, 1946, totaled 19,255,200 pounds molybdenum, which at the average rate of consumption for that year represents a 15 months' supply.

Domestic shipments for 1914–46 are shown in the accompanying table.

Molybdenum in ore and concentrates shipped from mines in the United States, 1914–46 [1]

Year	Pounds	Value [2]	Year	Pounds	Value [2]
1914–18	1,601,643	$2,070,213	1941	38,377,000	$25,996,000
1919–23 [3]	355,493	370,371	1942	66,437,000	47,275,000
1924–28	8,498,343	6,160,304	1943	53,955,000	38,500,000
1929–33	18,954,917	11,406,000	1944	39,423,000	27,999,000
1934–38	94,077,000	64,244,000	1945	32,524,000	23,107,000
1939	32,415,000	22,157,000	1946	16,304,000	11,167,000
1940	25,329,000	17,189,000			

[1] For shipments by years, 1914–38, see Minerals Yearbook, 1941, p. 629.
[2] Largely estimated by Bureau of Mines.
[3] No shipments in 1921 and 1922.

Total production declined 12,584,000 pounds of molybdenum (41 percent) in 1946 as compared to 1945. Production at straight molybdenum mines dropped 7,961,000 pounds (42 percent), while byproduct molybdenum decreased 4,623,000 pounds (39 percent). Byproduct molybdenum represented 39 percent of the total concentrates recovered in 1946, as compared to 38 percent in 1945 and 35 percent in 1944.

REVIEW BY STATES

Molybdenum was produced in six States in 1946, Colorado leading, followed in order by Utah, Arizona, New Mexico, Nevada, and California. The order was unchanged from that in 1945, except that Arizona and New Mexico exchanged places.

Arizona.—In 1946 there were two producers of molybdenite in Arizona, the byproduct recovery operations of the Miami Copper Co. at Miami, Ariz., and those of the Squaw Peak Copper Mining Co. at Camp Verde.

Diamond drilling on the San Manuel property by the Magma Copper Co. is reported to have developed 119 million tons of low-grade copper ore, of which 74.9 million tons is sulfide ore carrying 0.818 percent copper and a small but economically important quantity of molybdenum.[1]

California.—The sole producer of molybdenum in California is the United States Vanadium Corp. at Bishop, where the metal is recov-

[1] Mining Record, Another Great Copper Mine Discovered in Arizona: Vol. 57, No. 33, Aug. 15, 1946, p. 1.

ered as a byproduct of tungsten production. Molybdenum occurs as molybdenite and powellite.

Colorado.—Colorado continues to be the largest producing State and supplied virtually 60 percent of the domestic output in 1946.

Despite the enormous demands made by the war, the reserves of the Climax Molybdenum Co.,[2] the world's largest molybdenum company, increased. A drilling program was carried out during the war years which brought reserves of "proved or probable ore" to 260 million tons containing 1.6 billion pounds of molybdenum as compared with 145 million tons of ore containing 1.05 billion pounds of molybdenum recorded in 1935. It has been reported[3] that mining operations at Climax during World War II were confined to pulling broken ore reserves to achieve maximum production and that all ore breaking was suspended. A more balanced mining program was resumed late in 1946 with the hiring of 100 men to work a 5-day week.

The Urad mine of the Molybdenum Corp. of America at Empire, Colo., produced concentrates throughout 1946. Mining was curtailed pending the results of exploration by diamond drilling which was undertaken to define the limits and content of the ore body.[4]

Nevada.—The output from the Kennecott Copper Corp. at its McGill concentrator constitutes the only molybdenum production in Nevada. Ores from Kennecott's Ruth mine and Copper Flat open pit and from Consolidated Coppermines Corp.'s Emma Nevada group are milled at this concentrator.

New Mexico.—There are two producers of molybdenite in New Mexico, the Chino Mines Division of the Kennecott Copper Corp., Hurley, and the Molybdenum Corp. of America, Questa. At Hurley molybdenite has been recovered as a byproduct of copper operations since 1937. The Questa mine, which is operated for molybdenum only, has been a producer since 1919. The Questa mill, originally a 40-ton plant, has been enlarged to treat an additional 200 tons daily of accumulated tailings.[5]

Utah.—Utah continued to be the second-largest producing State because of the byproduct recovery of the Utah Copper Co. at Arthur and Magna. There was no other producer of molybdenum in the State.

EXPLORATION AND DEVELOPMENT

The Bureau of Mines has published reports[6] on three molybdenum-bearing properties: the Amargosa Molybdenum-Copper Property, Pima County, Ariz.; the Old Reliable Copper Mine, Pinal County, Ariz.; and the Bi-Metallic Molybdenum Deposit, Okanogan County, Wash.

[2] Mining World, Climax Reserves Climb Despite War Production: Vol. 8, No. 6, May 1946, p. 57. Mining Record, Climax Molybdenum Has Fine Reserve of Important Ore: Vol. 57, No. 22, May 30, 1946, p. 3.
[3] Mining World, vol. 8, No. 10, September 1946, p. 25.
[4] Skillings' Mining Review, Drill Out Molybdenum Deposit at Urad Mine: Vol. 34, No. 49, Mar. 23, 1946, p. 16. Mining World, vol. 8, No. 9, August 1946, p. 22.
[5] Mining World, vol. 8, No. 9, August 1946, p. 31. Mining Record, vol. 58, No. 7, Feb. 13, 1947, p. 3.
[6] Tainter, Stanton L., Amargosa (Esperanza) Molybdenum-Copper Property, Pima County, Ariz. Bureau of Mines Rept. of Investigations 4016, 1947, 15 pp.
Storch, R. H., Preliminary Exploration of Bi-Metallic Molybdenum Deposit, Okanogan County, Wash.: Bureau of Mines Rept. of Investigations 3932, 1946, 6 pp.
Denton, Thomas C., Old Reliable Copper Mine, Pinal County, Ariz.: Bureau of Mines Rept. of Investigations 4006, 1947, 9 pp.

During 1946 the Geological Survey reported no exploration of molybdenum properties.

CONSUMPTION AND USES

The largest single use for molybdenum is as an alloying element in the manufacture of alloy steels, for which molybdenum oxide, calcium molybdate, ferromolybdenum, and molybdenum-bearing scrap are used. Molybdic acid, sodium molybdate, molybdenum metal, and special molybdenum alloys enter into electrical and electronic equipment, laboratory chemicals, dry-color lakes, and special alloys.

In 1946 the consumption of molybdenum products entering into alloy steel decreased 46 percent as compared to 1945, whereas the production of alloy steel (excluding stainless) declined 30 percent. The comparable declines in 1945 as compared to 1944 were 16 and 20 percent, respectively. The lower consumption of molybdenum per ton of alloy steel in 1946 is largely accounted for by reversion of the market from military to civilian uses in which steels of lower alloy content are specified.

Consumption of molybdenum products in the United States, 1942–46, in thousands of pounds of contained molybdenum

Year	Ferromolybdenum	Calcium molybdate	Molybdenum oxide[1]	Other[2]	Purchased scrap	Total
1942	10,673	5,501	27,824	414	1,252	45,664
1943	6,663	5,099	26,383	580	2,940	41,665
1944	4,617	2,351	21,303	631	2,777	31,679
1945	4,560	2,166	17,583	989	1,631	26,929
1946	2,807	1,058	9,344	631	716	14,556

[1] Includes also molybdenum trioxide and molybdic acid.
[2] Ammonium molybdate, sodium molybdate, molybdenum silicide, molybdenum metal, and alloys.

The addition of molybdenum to various grades of stainless steel increases resistance to most chemical attack.

Despite the large decline in the consumption of molybdenum compounds entering into other-than-steel uses (a 36-percent decline from the 1945 consumption), these applications have increased 52 percent over 1942.

The use of molybdenite as a die lubricant has been proposed and described.[7]

Molybdenum is finding an expanding market in the alloys used in jet propulsion engines, turbo superchargers, and gas turbines. For these uses, molybdenum has been described as the best additive for high-temperature strength.[8] The utility of molybdenum in alloys for these severe services has received the recognition of engineers

[7] Norman, T. E., Molybdenite as a Die Lubricant: Metal Progress, vol. 150, No. 2, August 1946, p. 314.
[8] Badger, F. S., Cross, H. C., Evans, C. T., Jr., Franks, Russell, Johnson, R. B., Mochel, N. L., and Mohling, Gunther, Superalloys for High-Temperature Service in Gas Turbines and Jet Engines: Metal Progress, vol. 50, No. 1, July 1946, pp. 97–122, see editor's note, p. 168.
Fleischmann, Martin, 16-25-6 Alloy for Gas Turbines: Iron Age, vol. 157, No. 3, Jan. 17, 1946, p. 44.

not only in the United States but in England,[9] France,[10] and the U. S. S. R.[11]

STOCKS

The accompanying table presents year-end stocks of molybdenum concentrates and products in the hands of producers and consumers, 1941–46.

Year-end stocks of molybdenite and molybdenum products in the hands of producers and consumers, 1941–46

Year	Mo contained, thousands of pounds			Percent of 1941–46 average
	Concentrates	Products	Total	
1941	21,226	8,896	30,122	106.8
1942	12,540	8,465	21,005	74.5
1943	17,993	12,176	30,169	107.0
1944	19,335	8,740	28,075	99.6
1945	16,899	12,829	29,728	105.5
1946	19,255	10,793	30,048	106.6

PRICES

During 1946, the published price of molybdenite held at 45 cents per pound of MoS_2 in 90-percent concentrates. This has been the published price since 1938. This is an open market price, and contracts probably can be obtained at a somewhat lower figure, depending on the quantity involved, terms of payment, etc.

London prices for molybdenite (85 to 90 percent concentrates) were quoted at 40s. to 42s. 6d. per long-ton unit from January 1 to November 28, on which date the price was raised to 45s. to 47s. 6d.

The following prices for molybdenum products, which were quoted in the trade journals during the year, conformed to the maximum prices established by the Office of Price Administration in Maximum Price Regulation 489, dated November 8, 1943.

Product:	*Price per pound contained molybdenum*
Ferromolybdenum	$0.95
Molybdic oxide, technical, (powder or briquets)	.80
Calcium molybdate	.80

No price change occurred when molybdenum was removed from price regulation on June 12, 1946.

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[9] Monypenny, J. H. G., British E. N. Alloy Specifications: Iron Age, vol. 156, No. 20, Nov. 15, 1945, pp. 71–76.
Rudroff, D. W., Die Steel for Hot Work: Metallurgia, vol. 34, No. 202, August 1946, pp. 182–192.
Rothram, L., Some Aspects in the Development of Alloy Steels: Metallurgia, vol. 35, No. 206, December 1946, pp. 75–77.
Oliver, D. A., and Harris, G. T., Ferritic Discs for Gas Turbines: Metallurgia, vol. 34, No. 204, October 1946, pp. 293–295.
Metallurgia, Recent Developments on Materials for Gas Turbines: Vol. 34, No. 204, October 1946, pp. 316–320.

[10] Grenire, C., Les aciers inoxydables françaises: Chim. et ind., vol. 56, No. 6, December 1946, pp. 456–462.
Portevin, Albert M. (tr. by Baldwin, Wm. L., Jr.), Substitute Metallurgical Products: Metal Progress, vol. 50, No. 3, September 1946, pp. 485–494.

[11] Wolfson, S. E., and Myahkov, M. P. (tr. by Cosman, T.), Creep-Resistant Alloy Steels: Iron Age vol. 156, No. 5, Aug. 2, 1945, pp. 58–63.

FOREIGN TRADE [12]

Imports of molybdenum ore and concentrates into the United States are normally small, and the 1946 imports (276,475 pounds of contained molybdenum) show a decrease of 58 percent from those of the preceding year; 1946 records the second successive year of decline from the all-time high of 1944.

Of the 1946 imports, 276,465 pounds (molybdenum contained) were imported from Chile for reexport. No ferromolybdenum was imported in 1946.

Exports of molybdenum ore and concentrates were 564,924 pounds (contained molybdenum) valued at $371,024, a decrease of 80 percent in quantity from those in 1945.

Imports and exports of molybdenum ore and concentrates for 1945 and 1946 appear in the accompanying tables.

Molybdenum ore and concentrates imported for consumption in the United States, 1945–46, by countries

Country	1945			1946		
	Pounds		Value	Pounds		Value
	Gross weight	Molybdenum content		Gross weight	Molybdenum content	
Canada	[1] 887,153	[1] 460,416	[1] $443,359			
Chile	251,368	138,252	75,000	[1] 561,034	[1] 276,465	[1] $181,539
Mexico				60	10	86
Peru	124,753	66,131	48,126			
	1,263,274	664,799	566,485	561,094	276,475	181,607

[1] Imported for conversion and reexport.

Molybdenum ore and concentrates exported from the United States, 1945–46, by countries

Country	1945			1946	
	Pounds		Value	Pounds [1]	Value
	Gross weight	Molybdenum content		Molybdenum content	
Canada	1,176,800	705,633	$468,400	30,000	$24,000
Cuba				1,940	815
France	704,104	354,142	231,959		
Netherlands	22,400	12,544	10,097		
Sweden	191,400	115,364	91,954	301,031	172,109
U. S. S. R.	3,257,858	1,674,834	1,126,777		
United Kingdom				231,153	173,365
Venezuela				800	735
	5,352,562	2,862,517	1,929,187	564,924	371,024

[1] Beginning Jan. 1, 1946, gross weight not reported.

[12] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

WORLD REVIEW

Official production data on molybdenum have been published by several countries from which they were not available during World War II, notably Norway and French Morocco, and partial returns have been made by several other countries. All such data have been included in the accompanying table.

World production of molybdenum in ores and concentrates, 1938–46, by countries, in metric tons

[Compiled by B. B. Mitchell]

Country	1938	1939	1940	1941	1942	1943	1944	1945	1946
Australia [1]	32	39	20	24	7	15	9	(2)	(3)
Austria					4	5	6	(3)	(3)
Canada [1]	3	(2)	5	47	43	178	480	220	170
Chile		30	267	229	580	680	1,051	841	[4] 200
China:									
Manchuria [5]	(3)	(3)	(3)	75	384	516	516	30	[4] 50
Other Provinces [6]	3	3	7	5	3	(3)	(3)	(3)	(3)
Finland	(3)	(3)	47	148	126	108	110	92	[4] 50
Italy	4	4	21	18	17	(3)	(3)	(3)	(3)
Japan [7]	6	5	13	41	56	87	189	108	47
Korea (Chosen) [5]	54	54	96	96	96	180	270	24	(3)
Mexico	483	523	310	522	855	1,138	717	468	818
Morocco, French	66	90	35	31	6	7		(3)	(3)
Norway	462	427	287	229	368	227	248	[4] 50	[4] 100
Peru	92	165	166	146	154	85	62	29	[4] 4
Turkey	41	(3)	(3)	(3)	(3)	(3)	(3)		
United States	15,103	13,755	15,564	18,309	25,829	27,972	17,545	13,972	8,264
Other countries [8]	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
Total [4]	16,400	15,200	16,800	20,000	28,700	31,300	21,300	15,900	10,000

[1] Molybdenum content estimated by the author from gross weight of ore and concentrates reported.
[2] Less than 1 ton.
[3] Data not yet available; estimate included in total.
[4] Estimate by the author.
[5] Exports to Japan Proper.
[6] Data represent areas designated as Free China during the period of Japanese occupation.
[7] Preliminary data for fiscal year ended March 31 of year following that stated.
[8] Estimate by the author for Greece, Rumania, and Yugoslavia included in the totals; in addition, molybdenum ore is produced in Burma, France, Sweden, and U. S. S. R., but data of production are not available or are incomplete.

Austria.[13]—In the first quarter of 1946, 225 tons of molybdenum ore were mined in British-controlled Carinthia.

Canada.—According to preliminary estimates, the 1946 exports of molybdenum concentrates were 751,197 pounds valued at (C) $350,032 compared to 978,117 pounds valued at (C) $411,663 in 1945.[14] Claveau has reported[15] the presence of molybdenite in the rocks along the north shore of the St. Lawrence River in the region between Havre St. Pierre and the Olomane River.

McKean has described[16] a process for producing satisfactory molybdenite concentrates from ores containing MoS_2, bismuth, and copper.

Chile.—Exports of molybdenite in the first half of 1946 were 1,256 metric tons, compared to 418 tons during the corresponding period in 1945.[17]

[13] Metal Bulletin (London), Austrian Notes: No. 3124, Sept. 3, 1946, p. 4.
[14] Dominion Bureau of Statistics, Preliminary Report for 1946: Ottawa, 1947.
[15] Claveau, Jacques, Region of the North Shore of the St. Lawrence: Canadian Min. Jour., vol. 67, No. 6, June 1946, pp. 625–633.
[16] McKean, F. K., A Process for Cleaning Molybdenite Concentrate: Trans. Canadian Inst. Min. and Met., vol. 50, 1947, pp. 36–48.
[17] Bureau of Mines, Mineral Trade Notes: Vol. 23, No. 3, September 1946, p. 20.

Finland.[18]—During 1944, 194 tons of molybdenite concentrates were produced, of which 20 to 30 tons were consumed in Finland; the remainder was exported.

Greece.[19]—The concentrating plant installed by the Krupp Co. at Gevgeli is still intact but has remained idle. The mines are held under trusteeship by the Government.

Japan.—The production of molybdenite concentrates in 1946 (calendar year) was 99 metric tons containing about 80 percent MoS_2.

Manchuria.—A rich molybdenum deposit has been reported in Manchura.[20] During the war 300 Japanese technicians and staff and 6,000 Chinese were employed. Early estimates of the extent of reserves have been questioned.[21]

Mexico.—During the first half of 1946, 1,118 metric tons of molybdenum concentrates were produced and shipped to the United States.[22]

Norway.—An official report published by the Central Bureau of Statistics states that during the first half of 1946 no export shipments of molybdenite were made. In the same period of 1945, 207,621 kilograms were exported.[23]

Peru.—The reserves of Peru Molibdeno, S. A., the only producer of any consequence, were large, but development work was suspended during the war years. The supply of minable ore became exhausted, and the mine was shut down early in 1945; in consequence, the United States Commercial Co. canceled its contract because of failure of deliveries. Peru Molibdeno, S. A., subsequently experienced financial difficulties and was finally liquidated to satisfy creditors. All mining, concentrating, and other equipment has been sold.[24]

Rumania.[25]—Although several deposits of molybdenum-bismuth ores are known, the deposit at Baita is the only one known to have been exploited.

[18] Bureau of Mines, Mineral Trade Notes: Vol. 22, No. 3, March 1946, p. 19.
[19] Bureau of Mines, Mineral Trade Notes: Vol. 22, No. 2, February 1946, p. 17.
[20] Daily Metal Reporter, Rich Molybdenum Mine Is Discovered in Manchuria: Vol. 46, No. 116, June 18, 1946, p. 2.
Mining and Industrial Magazine of South Africa, Molybdenum in Manchuria: Vol. 34, No. 7, July 1946, p. 480.
[21] Daily Metal Reporter, Deposit of Molybdenum in Manchuria Held Unlikely: Vol. 46, No. 117, June 19, 1946, p. 4.
[22] Bureau of Mines, Mineral Trade Notes: Vol. 23, No. 5, November 1946, p. 19.
[23] Mining Journal (London), Norwegian Metal and Mineral Trade, January–June: Vol. 227, No. 5801, Oct. 26, 1946, p. 848.
[24] Bureau of Mines, Mineral Trade Notes: Vol. 22, No. 2, February 1946, p. 17.
[25] Bureau of Mines, Mineral Trade Notes: Vol. 23, No. 2, August 1946, p. 22.

Natural Gas

By F. S. LOTT AND H. BACKUS

	PAGE
General summary	805
Outlook	806
Government regulations	808
Reserves	808
Production	810
Gross production	810
Marketed production	812
Number of wells	812
Production—Continued	
Development and production by States	814
Interstate shipments and exports	823
Pipe-line developments	827
Consumption	828
Technologic developments	833

GENERAL SUMMARY

RESPONDING to demands that were limited in some market areas only by the capacity of available facilities, the marketed production of natural gas in 1946 is estimated to have expanded 4 percent over the 1945 record, to 4,095 billion cubic feet. All major classes of consumers used more gas except the electric utility power plants, whose requirements declined 19 billion cubic feet.

Domestic consumption, stimulated by an unusual increase in house-heating installations, approximated 650 billion cubic feet, or 7 percent more than in 1945. The increases in consumption by carbon-black and portland-cement plants were above the national average, reflecting higher rates of production by these industries. The demand for natural gas for miscellaneous industrial purposes was well maintained, a small increase in 1946 contrasting with a decline in the Federal Reserve Board index of industrial production from 203 in 1945 to 170 in 1946.

The average value at the wells of natural gas is estimated to have risen from 4.9 cents per thousand cubic feet in 1945 to 5.1 cents in 1946 owing to increased prices in many producing fields and to production gains in a few important areas where the field price is above the national average.

Estimates of the average value at points of consumption indicate an increase from 21.4 cents per thousand cubic feet in 1945 to 21.6 cents in 1946. (See fig. 1.) Except for higher average prices of gas for carbon-black manufacture, rates to consumers changed little. The greater volume of deliveries to domestic and commercial customers, however, was a primary influence in supporting the average sales value of all gas.

The export of natural gas by pipe line to Mexico decreased from the 1945 record total of 18,016 million cubic feet to 17,475 million in 1946. Capacity to deliver gas to Monterrey, Mexico, from south Texas fields will be augmented by completion of a new pipe line in 1947. The movement of natural gas across the Niagara River at

Buffalo for distribution in Ontario, Canada, increased to about 200 million cubic feet in 1946 from 191 million in 1945.

The number of domestic meters increased from 10,959,000 in 1945 to about 11,300,000 at the end of 1946. Similarly, commercial meters increased from 889,000 to about 950,000.

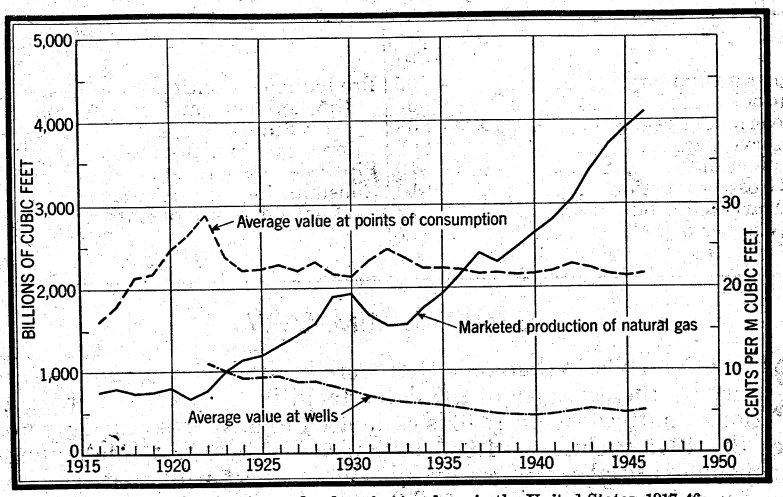

FIGURE 1.—Production and value of natural gas in the United States, 1917–46.

OUTLOOK

Two related factors—(1) the insistent public demand for greater supplies of natural gas and (2) the decline in cost of natural gas relative to other fuels in competitive geographic areas under the postwar price structure as compared to the immediate prewar years—have produced convincing evidence of a remarkable expansion in natural-gas transmission and sales for the next few years.

A large part of the demand for additional service is originating in areas where ample coal is available. The logic of the public urge for house heating with natural gas is attested, however, by trade reports that in parts of the northeastern States this fuel actually costs less under present rate structures than either coal or oil. The additions to the house-heating load are aggravating the problems of meeting peak-load requirements, particularly in the colder sections of the country. Of necessity, therefore, growing emphasis must be placed by distributing companies upon means of expanding effective peak capacities at points of consumption, such as underground storage, above ground storage, and supplemental standby capacity for manufactured gas or liquefied petroleum gases.

A number of companies now distributing manufactured or mixed gas may be expected to convert where possible to natural gas or to use a larger proportion of natural gas than currently, impelled by the rising unit costs of producing gas from coal or oil and by the desire to increase the effective capacities of their distribution systems without the need for large new capital investments. Selling a gas of materially higher B. t. u. value per cubic foot than at present would accomplish the latter objective.

Salient statistics of natural gas in the United States, 1942–46

	1942	1943	1944	1945	1946 [1]
Marketed production:					
California ..... millions of cubic feet	403,968	457,757	502,017	502,442	490,000
Louisiana ..... do	447,686	505,294	534,688	542,789	540,000
Oklahoma ..... do	269,704	285,045	310,888	357,530	380,000
Texas ..... do	1,170,345	1,323,885	1,525,515	1,711,401	1,815,000
West Virginia ..... do	215,193	223,787	181,452	160,225	180,000
Other States ..... do	546,579	618,921	656,479	644,299	690,000
Total production ..... do	3,053,475	3,414,689	3,711,039	3,918,686	4,095,000
Exports to—					
Canada ..... do	130	131	143	191	200
Mexico ..... do	8,572	11,079	14,433	18,016	17,475
Consumption:					
Domestic ..... do	498,537	529,444	562,183	607,400	650,000
Commercial ..... do	183,603	204,793	220,747	230,099	237,300
Industrial:					
Field ..... do	721,063	780,986	855,180	916,952	960,000
Carbon-black plants ..... do	335,533	315,562	355,770	431,830	478,349
Petroleum refineries ..... do	201,670	243,584	[2] 315,311	338,458	355,000
Portland-cement plants ..... do	64,540	51,748	35,588	38,349	57,681
Other industrial ..... do	1,039,827	1,277,362	[2] 1,351,684	1,337,391	1,338,995
Total consumption ..... do	3,044,773	3,403,479	3,696,463	3,900,479	4,077,325
Electric public-utility power plants [3] ..... do	238,736	305,576	359,745	326,190	306,905
Domestic ..... percent of total	16	16	15	16	16
Commercial ..... do	6	6	6	6	6
Industrial ..... do	78	78	79	78	78
Number of consumers:					
Domestic ..... thousands	10,135	10,354	10,669	10,959	11,300
Commercial ..... do	779	811	845	889	950
Industrial [4] ..... do	41	42	43	46	45
Number of producing gas wells	56,150	57,200	58,780	60,660	[5]
Value (at wells) of gas produced:					
Total ..... thousands of dollars	154,236	176,893	189,809	191,006	208,800
Average per M cubic feet ..... cents	5.1	5.2	5.1	4.9	5.1
Value (at point of consumption) of gas consumed:					
Domestic ..... thousands of dollars	352,520	370,558	388,359	415,122	440,005
Commercial ..... do	80,189	87,648	92,137	97,572	102,039
Industrial ..... do	258,458	300,731	313,775	321,501	338,600
Total value ..... do	691,167	758,937	794,271	834,195	880,644
Average per M cubic feet:					
Domestic ..... cents	70.7	70.0	69.1	68.3	67.7
Commercial ..... do	43.7	42.8	41.7	42.4	43.0
Industrial ..... do	10.9	11.3	10.8	10.5	10.6
Domestic and commercial ..... do	63.4	62.4	61.4	61.2	61.1
Domestic, commercial, and industrial ..... cents	22.7	22.3	21.5	21.4	21.6
Treated for natural gasoline:					
Quantity ..... millions of cubic feet	2,864,400	3,028,000	3,300,000	3,653,870	3,739,000
Ratio to total consumption	.94	.89	.89	.94	.92

[1] Subject to revision.
[2] Revised figure.
[3] Federal Power Commission. Figures include gas other than natural (impossible to segregate); therefore shown separately from other consumption.
[4] Exclusive of oil- and gas-field operators.
[5] Figure not yet available.

New and more efficient industrial applications of natural gas as a heat source, developed during and after the war, promise to maintain demand from many industries at high levels, as compared to prewar years. The important savings in labor cost and processing time often accomplished by use of gas compared to other fuels constitute under present economic conditions compelling reasons for its adoption as an aid to meeting competition.

The ability of the industry to satisfy fully the present and immediately prospective demands of consumers for natural gas will be retarded by delay in deliveries of the necessary pipe and equipment for large transmission facilities. Record demands for materials for

gas-line construction plus heavy requirements, worldwide, for crude-petroleum pipe lines of larger size than any built before the war will tax the capacity of pipe mills for many months—some reports indicate until 1950.

The period of vigorous expansion now in progress will continue to be based principally upon the vast available gas reserves of Texas and nearby States. These reserves, as at present defined, appear to be adequate to satisfy growing requirements for many years. Perhaps of greater significance for the future, however, is the evidence of rapid growth of available supplies in recent years and the promise of continuing large additions to the Nation's inventory as exploration and development continue.

GOVERNMENT REGULATIONS

Early in December 1946, the field price of natural gas in the Hugoton area of Oklahoma was fixed at 7 cents per thousand cubic feet on a pressure base of 14.65 pounds absolute by order of the Oklahoma Corporation Commission, about 3 cents above the local rates in commercial contracts. Legal action was begun shortly thereafter by purchasers of the gas to test the validity of this unusual order.

Acting in the interest of conservation of natural gas and petroleum, the Railroad Commission of Texas actively prosecuted a program of fact-finding and general inquiry into the problems involved in production and disposition of natural gas produced in many of the important oil fields in Texas. The purpose is to increase recoveries of crude petroleum and to reduce the waste of natural gas by requiring the use of more efficient methods of production. Coincident with these actions, a number of projects were commenced by the industry to construct facilities for processing natural gas to recover its contained liquids, and for marketing, or return to natural reservoirs, of the dry gas.

The Legislature of Louisiana, early in 1947, repealed the 1942 law that had placed restrictions upon the shipment of Louisiana-produced natural gas to other States that are adequately served by other fuels.

As an emergency measure to supplement supplies of natural gas to the Appalachian region during the winter of 1946–47, the War Assets Administration, on December 2, 1946, leased the two major war emergency pipe lines to a private corporation to carry Texas gas to Ohio and adjoining areas. Within a very few days, over 100 million cubic feet of gas daily were being delivered from these lines for distribution to consumers.

In 1946 the Federal Power Commission approved for construction pipe lines and related facilities for natural-gas transmission with an aggregate estimated cost of approximately $300,000,000. Applications were pending early in 1947 for authority to carry out additional construction at an estimated cost of over twice this amount.

RESERVES

The first of a planned series of annual estimates of the proved recoverable reserves of natural gas in the United States was reported by the Committee on Natural Gas Reserves of the American Gas

Association on October 7, 1946, and showed reserves as of December 31, 1945. A second report, as of December 31, 1946, indicating the changes, by States, during 1946 due to discoveries, extensions, revisions, and production, was released on February 28, 1947. The accompanying table summarizes the data in these reports.

Proved reserves of natural gas as defined by the committee "include the gas in both the drilled and certain undrilled portions of the fields. The undeveloped areas considered to have proved reserves are those so located with respect to the field geology and structure that production therefrom is practically assured. Recoverable reserves of natural gas are the reserves estimated to be producible under existing operating practices."

The three types into which gas reserves have been divided are defined as follows: 1. Nonassociated gas is free gas not in contact with crude oil in the reservoir. 2. Associated gas is free gas in contact with crude oil in the reservoir. 3. Dissolved gas is gas in solution in crude oil in the reservoir.

Estimated proved recoverable reserves of natural gas in the United States, 1945–46, in millions of cubic feet[1]

[Committee on Natural Gas Reserves, American Gas Association][2]

	Reserves as of Dec. 31, 1945	Changes in reserves during 1946			Reserves as of Dec. 31, 1946			
		Discoveries, extensions, and revisions	Net production[3]	Net increase	Total	Non associated	Associated	Dissolved[2]
Alabama	23	75	1	74	97			97
Arkansas	869,686	54,171	52,195	1,976	871,662	447,651	162,276	261,735
California	10,855,707	803,056	532,462	270,594	11,126,301	3,687,430	3,198,714	4,240,157
Colorado	396,282	−70,905	9,614	−80,519	315,763	155,440	41,075	119,248
Illinois	268,000	33,500	33,500		268,000	3,000	55,000	210,000
Indiana	17,000	3,200	3,200		17,000	4,000	8,000	5,000
Kansas	13,250,605	636,771	206,532	430,239	13,680,844	13,257,617	212,310	210,917
Kentucky	1,436,800	44,200	95,000	−50,800	1,386,000	1,299,000		87,000
Louisiana	19,849,393	3,170,050	607,932	2,562,118	22,411,511	18,323,314	2,697,126	1,391,071
Michigan	8,931	148,069	26,000	122,069	131,000	76,200		54,800
Mississippi	2,007,859	383,842	21,188	362,654	2,370,513	1,731,821	446,098	192,594
Montana	1,202,521	−319,521	29,599	−349,120	853,401	853,401		
Nebraska	375	−374		−374	1			1
New Mexico	5,190,309	899,737	185,260	714,477	5,904,786	3,079,900	2,132,911	691,975
New York	76,000	900	7,000	−6,100	69,900	69,000		900
Ohio	626,800	46,200	59,000	−12,800	614,000	573,000		41,000
Oklahoma	10,079,938	1,311,816	655,908	655,908	10,735,845	7,572,279	1,589,538	1,574,028
Pennsylvania	520,000	61,000	78,000	−17,000	503,000	453,000		50,000
Texas	78,306,676	10,154,021	2,097,238	8,056,783	86,363,459	62,345,192	15,282,025	8,736,242
West Virginia	1,928,300	116,700	205,000	−88,300	1,840,000	1,739,000		101,000
Wyoming	816,763	252,379	33,545	218,834	1,035,597	693,191	235,176	107,230
Florida, Missouri, and Utah	81,399	265	4,443	−4,178	77,221	76,900		321
Total	147,789,367	17,729,152	4,942,617	12,786,535	160,575,901	116,440,336	26,060,249	18,075,316

[1] Volumes are reported at a pressure base of 14.65 pounds per square inch absolute and at a standard temperature of 60° F.

[2] Reserves of *dissolved* gas were estimated jointly with American Petroleum Institute Committee on Petroleum Reserves.

[3] Net production equals estimated gross withdrawals less gas reinjected into underground reservoirs.

In connection with the study of natural-gas reserves, estimates were made also of the quantity of natural gas liquids contained in recoverable gas reserves and extractable by methods now in use. The term "natural gas liquids" is used to describe "those hydrocarbon liquids

that are gaseous in the reservoir but are obtainable by condensation or absorption." The estimated reserve of such liquids in the United States on December 31, 1946, amounted to 3,354 million barrels. Details of this estimate are shown in the Natural Gasoline and Liquefied Petroleum Gases chapter of this volume.

PRODUCTION

GROSS PRODUCTION

The total production of natural gas from oil and gas wells is estimated to have increased 5 percent over 1944, to 5,902,180 million cubic feet in 1945. Large gains in Texas and Oklahoma were influenced by greater demand from interstate transmission systems whose takings offset material declines in production in the Appalachian region and in Kansas. As a result of active development of dry-gas reserves and cycling in condensate fields, withdrawals from gas wells have increased from 57 percent of total gas production in 1940 to 66 percent in 1945.

The approximate rate at which the Nation's gas reserves are being depleted is indicated by subtracting from estimated gross production the quantities of gas returned to natural, underground reservoirs for purposes of repressuring, pressure maintenance, and storage. In 1945, a total of 4,814,894 million cubic feet of natural gas was removed from available gas reserves and consumed or otherwise dissipated, an increase of 2 percent over 1944. Compared with an indicated withdrawal of 2,396,421 million cubic feet in 1935, the 1945 rate shows an increase of 101 percent in 10 years. In the 11 years 1935–45, inclusive, approximately 38.3 trillion cubic feet of natural gas has been taken from underground reserves.

The largest element of growth in repressuring and pressure maintenance in recent years has been related to cycle-plant operations in which great quantities of gas are returned to condensate-type reservoirs after processing to recover liquid products. In Texas and Louisiana, where 85 percent of all gas returned to natural reservoirs for these purposes was reported in 1945, cycle plants are the dominant influence. In California, which accounts for another 10 percent of the total, these plants are also a factor.

The operation of storage reservoirs in 1945 involved the injection of 61,502 million cubic feet of natural gas and the withdrawal to meet peak demands of 36,167 million cubic feet, resulting in a net increase in stored gas during the year of 25,335 million cubic feet. In the West Virginia-Pennsylvania-Ohio area, larger supplies from southwestern fields facilitated the input to storage of a record volume of gas and a net gain of 15.5 billion cubic feet in inventories. The total volume of gas in storage fields in the Appalachian region on December 31, 1945, is estimated to exceed 70 billion cubic feet, excluding gas that is usually regarded as a "cushion" not readily available for market. The great value of integrated gas-storage facilities in important consuming districts is now widely recognized, not only as an economical means of increasing notably the effective capacity of a gas-transmission system to serve communities with pronounced variations in seasonal requirements, but also as a vital factor in pro-

Gross production and disposition of natural gas in the United States, 1944–45, by States, in millions of cubic feet

State	Estimated production [1]			Estimated disposition			
	From gas wells	From oil wells	Total	Marketed production	Repressuring	Stored in ground (net)	Losses and waste [2]
1944							
Arkansas	44,000	38,000	82,000	46,453	10,520	171	24,856
California	187,000	430,000	617,000	502,017	85,000	3,785	26,198
Colorado	5,000	1,000	6,000	5,141	453		406
Illinois	1,000	54,000	55,000	18,137	8,500	382	27,981
Indiana	900	1,200	2,100	1,014	674	145	267
Kansas	118,000	48,000	166,000	157,733	2,206	[3] −401	12,417
Kentucky	93,000	10,000	103,000	94,223	700	−400	8,228
Louisiana	609,000	191,000	800,000	534,688	116,771		148,541
Michigan	21,000	4,000	25,000	19,653		1,123	4,224
Mississippi	1,000	1,700	2,700	1,352			1,348
Missouri	160	10	170	159			11
Montana	31,300	1,700	33,000	32,102	25		873
New Mexico	30,000	104,000	134,000	87,727	2,860	104	43,309
New York	7,440	260	7,700	7,052	60	[3] 2	578
Ohio	53,000	4,000	57,000	51,724	6	[3] 3,196	6,533
Oklahoma	218,000	147,000	365,000	310,888	15,919	2,111	32,057
Pennsylvania	95,000	5,000	100,000	92,987	1,436	[3] 993	6,676
Texas	1,908,000	889,000	2,797,000	1,525,515	624,000		643,751
West Virginia	194,500	9,500	204,000	181,452	1,607	[3] −1,556	18,007
Wyoming	26,000	25,000	51,000	34,521	12,242	262	3,975
Other States [4]	6,530	20	6,550	6,501			49
Total	3,649,830	1,964,390	5,614,220	3,711,039	882,979	9,917	1,010,285
1945							
Arkansas	39,000	37,000	76,000	46,600	11,400	250	17,750
California	188,000	446,000	634,000	502,442	102,724	144	28,690
Colorado	4,200	1,800	6,000	4,914			1,086
Illinois	500	49,500	50,000	16,663	7,417	415	25,505
Indiana	1,100	1,400	2,500	1,543	564	[3] 345	427
Kansas	107,000	46,000	153,000	145,959	2,032	[3] 791	11,718
Kentucky	83,000	11,000	94,000	81,714	701	[3] 286	8,325
Louisiana	618,000	180,000	798,000	542,789	131,812		123,399
Michigan	18,000	7,000	25,000	21,874		−201	3,327
Mississippi	1,900	6,750	8,650	4,587			4,063
Missouri	77	23	100	90			10
Montana	30,300	2,200	32,500	31,829			671
New Mexico	33,000	107,000	140,000	105,023	7,621	673	26,683
New York	10,150	250	10,400	9,210		[3] 595	589
Ohio	51,500	3,500	55,000	49,967	10	[3] 4,529	5,923
Oklahoma	249,000	177,000	426,000	357,530	15,973	6,464	40,362
Pennsylvania	85,500	4,500	90,000	82,188	2,233	[3] 5,181	4,721
Texas	2,160,000	900,000	3,060,000	1,711,401	767,140		572,430
West Virginia	173,500	8,500	182,000	160,225	924	[3] 5,785	15,115
Wyoming	27,000	25,000	52,000	35,282	11,400	78	5,240
Other States [4]	7,000	30	7,030	6,856			174
Total	3,887,727	2,014,453	5,902,180	3,918,686	1,061,951	25,335	896,208

[1] Marketed production plus quantities used in repressuring, stored in ground, lost, and wasted (see footnote 2).

[2] Includes gas (mostly residue gas) blown to the air and transportation losses but does not include direct waste on producing properties, except where data are available.

[3] Includes gas transported from other States.

[4] Florida, North Dakota, South Dakota, Tennessee, Utah, and Virginia.

moting continuity of service by minimizing the danger of interruptions to supply, particularly from sources far removed from the principal focuses of demand.

The indicated loss and waste of gas declined from 1,010,285 million cubic feet in 1944 to 896,208 million in 1945 owing primarily to material reductions in Texas, Louisiana, New Mexico, and Arkansas. Increased sales of residue gas to pipe lines and carbon-black manufacturers were factors contributing to this improvement, particularly in Texas and New Mexico.

MARKETED PRODUCTION

The quantity of natural gas produced and marketed again surpassed previous records, reaching 3,918,686 million cubic feet in 1945, a 6-percent increase over 1944. As in other recent years, the largest gains were in important producing States of the Southwest, led by Texas, Oklahoma, New Mexico, and Louisiana.

The average value at the wells of natural gas in these four States as a group was less than 3 cents per thousand cubic feet in 1945. They produced 69 percent of the marketed production of natural gas in the United States in 1945, compared with 66 percent in 1944.

On the other hand, material reductions in output were reported in all of the five producing States of the Appalachian region, except New York, where a small gain resulted from exploitation of a recently developed high-pressure field. The average well-head value of natural gas in these States exceeded 17 cents per thousand cubic feet in 1945. Collectively, they produced 10 percent of United States marketed production in 1945, compared with 12 percent in 1944.

The above conditions account, in large part, for the decline in average value at the wells of natural gas in the United States from 5.1 cents per thousand cubic feet in 1944 to 4.9 cents in 1945. The average for individual areas was higher in 15 States in 1945 and lower in 7.

Natural gas produced in the United States and delivered to consumers, 1941–45, by States, in millions of cubic feet

Year	Arkansas	California	Colorado	Illinois	Indiana	Kansas	Kentucky	Louisiana	Michigan	Mississippi	Montana	New Mexico
1941	19,148	374,905	3,256	10,053	1,522	111,121	69,067	403,855	13,916	4,268	28,499	64,655
1942	19,456	403,968	4,865	14,484	1,599	112,921	80,089	447,686	15,521	2,082	31,475	78,164
1943	36,469	457,757	6,445	18,120	1,450	133,729	92,364	505,294	18,006	1,461	31,562	86,500
1944	46,453	502,017	5,141	18,137	1,014	157,733	94,223	534,688	19,653	1,252	32,102	87,727
1945	46,600	502,442	4,914	16,663	1,543	145,959	81,714	542,789	21,874	4,587	31,829	105,023

Year	New York	Ohio	Oklahoma	Pennsylvania	Texas	West Virginia	Wyoming	Other States	Total	Value at point of consumption	
										Total (thousands of dollars)	Average (cents per M)
1941	10,456	41,858	234,054	92,819	1,086,312	207,681	29,284	5,929	2,812,658	621,333	22.1
1942	8,718	45,055	269,704	93,532	1,170,345	215,193	33,124	5,494	3,053,475	692,737	22.7
1943	8,062	52,001	285,045	93,543	1,323,885	223,787	34,351	4,858	3,414,689	760,950	22.3
1944	7,052	51,724	310,888	92,987	1,525,515	181,452	34,521	6,660	3,711,039	797,255	21.5
1945	9,210	49,967	357,530	82,188	1,711,401	160,225	35,282	6,946	3,918,686	837,852	21.4

NUMBER OF WELLS

Fewer gas-well completions in Pennsylvania, Texas, Kentucky, and West Virginia in 1946 caused a reduction in the United States total to 3,090 from 3,235 in 1945. Among the Eastern States, Ohio experienced a notable increase in gas development. Intensive, continued drilling in the Hugoton area of Kansas and Oklahoma contributed to

Natural gas produced and consumed in the United States in 1945, by States

State	Produced and delivered to consumers, including deliveries in other States						Consumed, including receipts from other States			
	Quantity		Estimated value at wells		Value at point of consumption		Quantity		Value at point of consumption	
	Millions of cubic feet	Percent of total	Total (thousands of dollars)	Average (cents per M)	Total (thousands of dollars)	Average (cents per M)	Millions of cubic feet	Percent of total	Total (thousands of dollars)	Average (cents per M)
Alabama							43,417	1.1	9,475	21.8
Arizona							22,488	.6	6,665	29.6
Arkansas	46,600	1.2	1,146	2.5	6,145	13.2	91,198	2.3	12,060	13.2
California	502,442	12.8	30,147	6.0	136,241	27.1	502,442	12.9	136,241	27.1
Colorado	4,914	.1	239	4.9	1,334	27.1	34,877	.9	11,420	32.7
District of Columbia							6,883	.2	4,793	69.6
Florida	6	(1)	(2)	3.0	(2)	3.0	7,331	.2	1,432	19.5
Georgia							35,915	.9	12,159	33.9
Illinois	16,663	.4	1,015	6.1	2,883	17.3	121,366	3.1	52,641	43.4
Indiana	1,543	(1)	169	11.0	1,223	79.3	40,274	1.0	18,743	46.5
Iowa							27,794	.7	10,458	37.6
Kansas	145,959	3.7	7,429	5.1	49,039	33.6	160,406	4.1	31,341	19.5
Kentucky	81,714	2.1	12,510	15.3	37,078	45.4	26,802	.7	11,552	43.1
Louisiana	542,789	13.9	19,323	3.6	90,873	16.7	325,888	8.4	33,787	10.4
Maryland							2,584	.1	1,895	73.3
Michigan	21,874	.6	2,898	13.2	14,861	67.9	59,594	1.5	45,731	76.7
Minnesota							35,930	.9	11,704	32.6
Mississippi	4,587	.1	216	4.7	1,076	23.5	38,297	1.0	8,992	23.5
Missouri	90	(1)	7	7.8	47	52.2	72,059	1.8	29,118	40.4
Montana	31,829	.8	1,499	4.7	8,648	27.2	29,575	.8	7,553	25.5
Nebraska							28,235	.7	9,945	35.2
New Mexico	[3] 105,023	2.7	1,460	1.4	16,173	15.4	71,459	1.8	6,866	9.6
New York	[4] 9,210	.2	2,629	28.5	5,919	64.3	29,577	.8	21,804	73.7
North Dakota	217	(1)	7	3.2	80	36.9	2,640	.1	1,035	39.2
Ohio	49,967	1.3	8,899	17.8	25,973	52.0	172,258	4.4	91,039	52.9
Oklahoma	357,530	9.1	12,764	3.6	66,014	18.5	249,927	6.4	31,486	12.6
Pennsylvania	[5] 82,188	2.1	20,169	24.5	43,094	52.4	149,092	3.8	65,419	43.9
South Dakota	5	(1)	(2)	4.9	2	40.0	7,158	.2	2,541	35.5
Tennessee	10	(1)	1	10.0	5	50.0	24,419	.6	7,577	31.0
Texas	[6] 1,711,401	43.7	44,839	2.6	253,845	14.8	1,348,140	34.6	104,064	7.7
Utah	6,562	.2	332	5.1	1,685	25.7	20,264	.5	5,202	25.7
Virginia	56	(1)	6	10.7	53	94.6	1,791	(1)	1,582	88.3
West Virginia	160,225	4.1	21,887	13.7	67,665	42.2	88,757	2.3	23,864	26.9
Wyoming	35,282	.9	1,415	4.0	7,896	22.4	21,642	.6	4,011	18.5
Total: 1945	3,918,686	100.0	191,006	4.9	837,852	21.4	3,900,479	100.0	834,195	21.4
1944	3,711,039	100.0	189,809	5.1	797,255	21.5	3,696,463	100.0	794,271	21.5

[1] Less than 0.05 percent.
[2] Less than $500.
[3] Includes 3,281 millions of cubic feet piped to Mexico.
[4] Includes 31 millions of cubic feet piped to Canada.
[5] Includes 160 millions of cubic feet piped to Canada.
[6] Includes 14,735 millions of cubic feet piped to Mexico.

important gains in gas completions in these States in 1946. Sharp increases over 1945 were reported also in Michigan, Montana, and New Mexico.

The number of producing gas wells increased 1,880 during 1945 to 60,660 on December 31. Of the total net increase, 1,110 were in the 5 principal southwestern gas-producing States and 650 in the 5 Appalachian States.

The total number of gas wells (net) abandoned or shut in during 1945 was 1,355. Of this number, 184 were in the 5 Southwestern States and 1,079 in the 5 Appalachian States.

Gas wells in the United States, 1944–46, by States

State	Producing Dec. 31, 1944	Drilled during 1945 [1]	Producing Dec. 31, 1945	Drilled during 1946 [1]
Arkansas	180		180	2
California	200	56	250	65
Colorado	20	1	20	1
Illinois	80	1	80	6
Indiana	810	28	820	25
Kansas	2,040	201	2,220	300
Kentucky	[2] 3,090	221	[2] 3,250	139
Louisiana	1,820	108	1,900	115
Michigan	630	54	640	107
Mississippi	20	[3] 8	20	6
Missouri	110	4	110	
Montana	580	49	620	71
New Mexico	130	21	150	42
New York	1,990	7	1,850	8
Ohio	6,950	404	7,000	543
Oklahoma	2,450	250	2,680	341
Pennsylvania	19,000	520	19,300	271
Tennessee	(2)		(2)	
Texas	3,800	714	4,400	499
West Virginia	14,720	577	15,000	535
Wyoming	130	10	140	11
North Dakota, South Dakota, Utah, and Virginia	30	1	30	3
	58,780	[3] 3,235	60,660	3,090

[1] From Oil and Gas Journal and State sources.
[2] Tennessee included with Kentucky.
[3] Revised figure.

DEVELOPMENT AND PRODUCTION BY STATES

Arkansas.—Gas production from the controlled oil and condensate fields in south Arkansas declined from 58,085 million cubic feet in 1945 to 57,517 million in 1946, according to the Arkansas Oil and Gas Commission.

Because of a lack of market for the gas, the Columbia pool was shut in during 1946, and the Texarkana and Salem Church pools were shut in during the first half of the year. The dry-gas fields of north Arkansas produced 5,132 million cubic feet of gas in 1945 and 3,655 million in 1946.

No dry-gas discoveries were reported. The Warnock Springs field, Columbia County, was opened in December 1946 by a well that produced 50 barrels of condensate with 4.5 million cubic feet of gas daily from Smackover limestone below 7,400 feet.

California.—According to information from the California Department of Natural Resources and the Public Utilities Commission, three dry-gas fields were discovered in 1946 in the area north of the Rio Vista field. The Winters area in Solano County was opened by a well that produced 11 million cubic feet of gas per day from the Eocene formation at a depth of 5,200 feet. A well in the Dunnigan Hills area, Yolo County, produced 3,030 thousand cubic feet of gas daily through a ⅜-inch choke from sands at 2,400 to 2,520 feet, tentatively classified as Meganos (Lower Eocene). The third gas discovery, in the Durham area, Butte County, was made by a well that flowed 10,900 thousand cubic feet daily through a ⅞-inch choke from Eocene sands at 2,140 to 2,176 feet. Extensions to several fields in Sacramento, Solano, and Tehama Counties were reported.

In the south San Joaquin Valley district, indicated reserves of the

Trico gas field were greatly enlarged by a northwest extension of the First Mya zone and by discovery of a new zone of production 800 feet below it. The recoverable reserve of gas is estimated at 255 billion cubic feet.

An important pipe-line development was the return to natural-gas service in mid-1946 of the Standard-Pacific Gas line from Kettleman Hills to the San Francisco Bay area. As a war measure, this line had carried oil since 1942. The completion of a gas-line system to the same area from the Rio Vista-Cache Slough-Kirby Hills-Suison Bay-Honker Bay fields augmented supplies of gas from the Rio Vista and several other fields not previously connected to markets.

The known natural-gas reserves of California were estimated on January 1, 1946, to be 11,421 billion cubic feet, of which 6,838 billion consisted of oil-field (casinghead) gas and 4,583 billion dry gas in place or stored underground.

Net natural-gas withdrawals from formations were 554,486 million cubic feet in 1945 and 532,454 million in 1946, according to R. M. Bauer, Southern California Gas Co. Oil-well gas declined from 366,640 million cubic feet to 352,204 million, and dry-gas withdrawals from 187,846 million to 180,250 million. Production from the Rio Vista gas field was, in millions of cubic feet, 159,580 in 1945 and 148,883 in 1946. Gas used for repressuring, not included above, amounted to 105,524 million cubic feet in 1946.

Colorado.—J. R. Schwabrow, Federal Geological Survey, reported no gas discoveries in Colorado during 1946. One gas well was drilled in the East Hiawatha field. A deep test at Piceance Creek was unsuccessful at 12,019 feet; it was plugged back to production at 3,048–3,118 feet in the Green River-Wasatch contact zone. These two wells had an open flow of 7,240,000 cubic feet.

A pressure-maintenance project in the North Callum field returned 9,514 million cubic feet of carbon-dioxide gas to the sand, 18 million were used in the manufacture of dry ice, and 5,241 million were lost. Corrosion problems prevented further drilling or plant expansion. (These figures are not included in the natural-gas statistics.)

The Rangely field produced 2,738 million cubic feet of natural gas with oil, of which 1,917 million were used in the field and 821 million were lost. The Wilson Creek field produced 529 million cubic feet, 151 million being consumed in the field, 127 million recycled, and 251 million lost. In the Hiawatha field, 372 million cubic feet were used for pressure maintenance.

The Piceance Creek, White River, and Douglas Creek fields were shut in. Some of the gas may eventually be used at nearby towns, but long pipe-line connections do not seem practical as yet.

Metered production in Colorado, which has declined since 1942, increased 16 percent, from 4,247 million cubic feet in 1945 to 4,941 million in 1946. Powder Wash and Thornburg fields accounted for this increase as other fields registered declines. Production by fields, in millions of cubic feet, was: Powder Wash, 2,488; Hiawatha, 2,118; Thornburg, 299; Berthoud, 35; and Craig, 1.

Gross production was divided as follows: Marketed production, 4,941; repressured and recycled, 500; field use, 2,185; and losses, 1,076. Increases of 236 percent in field use and 140 percent in losses over 1945

records are due to increased oil production at Wilson Creek and increased drilling and oil production at Rangely.

Illinois.—The following information was contributed by A. H. Bell and D. H. Swann of the Illinois State Geological Survey.

There were six gas completions in Illinois in 1946. The wells were drilled in the Panama and Waverly gas pools discovered or named during the year. The pools have no outlets, and none of the gas was marketed. Sales of gas for domestic use from the Storms pool, discovered in 1939, began in October 1946.

Approximately 22,170 million cubic feet of gas were processed at gasoline plants during the year, compared with 21,000 million in 1945. It is estimated that 8,000 million cubic feet of residue gas were used for repressuring in 1946, 288 million marketed, 8,000 or 9,000 million used for plant or lease fuel, and about 100 million burned in flares.

Estimates of casinghead gas from pools with no gasoline plants or pipe-line connections indicate that the amount of gas flared has increased over that of previous years. Wells less than a year old produced from 15 to 20 billion cubic feet, of which not more than 10 percent was utilized. Of the 15 to 25 billion cubic feet produced by older wells, 50 to 75 percent was used for lease fuel and about 1 percent for pressure maintenance, the remainder being wasted.

It is estimated that approximately 60 billion cubic feet of gas were produced in Illinois in 1946, an increase of 10 billion over the 1945 estimate. About 60 percent of the 1946 output was utilized in some manner, and 40 percent was wasted.

Distributing companies marketed 336 million cubic feet of gas from the Russellville gas field, 16 from the Ayers gas field, 288 of residue gas from gasoline plants in the Louden field, and 10 from the Storms oil field. These figures indicate an increase of 36 percent over 1945 sales.

Indiana.—Gas-well completions declined from 36 in 1945 to 25 in 1946. The principal fields of activity, with the number of new gas wells in each, were Greensburg, 7; Trenton, 6; Iva, 4; and Union-Bowman, 3. A small discovery well was reported in Trenton limestone in Fayette County—in the southeastern part of the old Trenton field—and a shallow gas well was indicated in La Porte County in the northern part of the State.

Kansas.—Reported gas-well completions numbered 300 in 1946, compared with 201 in 1945, reflecting increased drilling in the Hugoton field, where 265 wells were completed in 1946, a gain of 84 over 1945. Several thousand acres were added to the productive area of this field around its northern portion. Production of gas declined about 1 percent to 122.6 billion cubic feet in 1946. Larger withdrawals from Hugoton failed to offset declines in other areas.

Six gas-field discoveries were reported in 1946, as follows: Producing from the Mississippi limestone, the Donald field in Barber County, the Lehigh field in Marion, and the Bartholomew field in Sedgwick; producing from the Viola limestone, the Stoops field in Pratt County; producing from a shallow Permian sand, a small well in Wyandotte County. An extension of the Boggs field, Barber County, produced gas from the Simpson formation. Much additional acreage beyond the limits of the Hugoton field was leased by operators during 1946.

Kentucky.—Drilling for gas apparently declined in eastern Ken-

tucky, as indicated by 112 gas-well completions in 1946, compared with 216 in 1945. In the western district, an increase from 5 in 1945 to 27 in 1946 resulted chiefly from development of the new Dixie field, where 17 gas wells were drilled.

Development of gas and oil production in the Big Six sand is expected to stimulate deeper drilling in many old areas producing from younger formations in the eastern part of the State. Three tests of the Knox dolomite drilled in 1946 in Clinton, Rowan, and Powell Counties found showings of oil or gas. These indications will probably lead to further deep exploration.

Discovery of two gas fields was reported. The Owensboro field, Daviess County, was opened in April by a well that produced 5.3 million cubic feet of gas per day from Waltersburg sand at 1,158–1,168 feet. The Dixie field, Henderson County, was discovered in January, when Pennsylvanian sand production of 1.5 million cubic feet of gas per day was found at a depth of 1,030 to 1,050 feet.

Louisiana.—Gas and condensate completions numbered 172 in 1946, compared with 147 in 1945. Of the 1946 total, 24 condensate and 93 gas wells were in the Northern district and 48 condensate and 7 gas wells in the Gulf district.

Discoveries included two condensate fields in the north, and in the Gulf area three condensate and one gas field ranging in depth from 6,580 to 11,400 feet. The new condensate fields were Killen's Ferry in Franklin Parish, Choudrant in Lincoln, Johnson's Bayou in Cameron, East Barataria Bay in Jefferson, and Big Point in St. Tammany. The gas discovery was at South Shuteston in St. Landry Parish. In addition, 16 new horizons were opened for condensate production and 4 for dry-gas production, most of which were in the Gulf district at depths below 8,000 feet.

The production of gas from oil wells declined from 178,846 million cubic feet in 1945 to 167,171 million in 1946, according to State reports. Production from gas and condensate wells declined also from 617,300 million cubic feet to 591,997 million cubic feet.

Michigan.—Information on gas developments in Michigan was taken from a report of the Michigan Department of Conservation.

Gas completions in the State increased from 63 in 1945 to 139 in 1946. Six gas fields were discovered and two were extended. The total number of producing wells increased from 675 at the end of 1945 to 766 at the end of 1946. Seventy-six of the latter were drilled in fields being prepared for gas storage or in old fields to facilitate the production of any remaining gas and do not add to gas reserves. They were located as follows: Austin, Mecosta County (used for storage since 1942), 19; Marion, Clare and Osceola Counties, 33; Reed City, Osceola and Lake Counties, 7; Goodwell, Newaygo County, 3; Lincoln, Clare County, 14. Marion, Reed City, and Goodwell fields are being prepared for storage.

Counties having the most completions were Clare 39, Isabella 15, Mecosta 31, and Osceola 27. The basin district in the central part of Michigan produced 91 percent of the reported output and accounted for 91 percent of new wells drilled. The largest discovery well was a distillate-gas well in the Freer field of Clare County. It was also the deepest at 5,038 feet.

Production totaled 23,774 million cubic feet in 1946, a 2-percent gain over the 1945 output.

Mississippi.—H. M. Morse, supervisor, Mississippi State Oil and Gas Board, states that there were no important gas discoveries in Mississippi during 1946. Eight gas wells were completed in the Gwinville field during the year and pipe-line connections were being made. A repressuring project was in operation in the Cranfield field. A total of 17,083 million cubic feet of gas was produced in 1946, more than twice the 1945 output. Sales from nine fields totaled 3,644 million, and 13,439 million were used for fuel and flared in various fields. Gas is valued at 6 to 6.25 cents a thousand cubic feet at the well.

Missouri.—Frank C. Greene, geologist, Missouri Geological Survey, reports only 4 gas wells (all in Jackson County) drilled in Missouri in 1946, compared with 17 in four counties in 1945. Gas production decreased 51 percent from 77.6 million cubic feet in 1945 to 37.9 million in 1946.

Montana.—According to J. R. Schwabrow, Federal Geological Survey, 83 gas wells were drilled in Montana during 1946, compared with 49 in 1945. Completions by fields were: Bowdoin, 33; Cedar Creek, 13; Cut Bank, 10; Kevin-Sunburst, 5; Hardin, 7; Devon, 4; and miscellaneous fields, 11.

A discovery of undetermined importance was made by a well 2,036 feet deep in the Kootenai formation at Apex in the Sweetgrass Hills area. Estimated production was 10 million cubic feet at 450 pounds pressure. A deep test was reported at Utopia in the Devonian sand with 10 million cubic feet production. The Hardin field was extended and 5 wells were drilled and shut in west of the southern part of the Cedar Creek field. The Bow and Arrow, Havre, and Kicking Horse fields were connected with pipe lines during the year.

Gas storage in the north end of the Cedar Creek field, which began in May 1945, was continued in 1946, when 186 million cubic feet were injected during the summer. Repressuring oil sands utilized 98 million cubic feet in the Cut Bank field in 1946. Of the four projects in the field, one, operated only 14 days in October 1945, arrested the decline of oil production and increased pressures; one of the three started in 1946 resulted in a 20-percent increase in production, and two showed no results.

Metered production totaled 31,136 million cubic feet in 1946, compared with 31,064 million in 1945. Production of major fields in millions of cubic feet was: Bowdoin, 5,885; Cedar Creek, 5,167; Cut Bank, 14,100; Dry Creek, 1,242; and Kevin-Sunburst, 2,225. Compared with the 1945 output, all fields registered decreases except Bowdoin and Dry Creek, which increased.

Gross production was 33,147 million cubic feet in 1946 (32,344 in 1945), as follows: Marketed production, 31,136; repressuring, 132; field use, 1,130; and losses, 749. The largest gains, in repressuring and losses, were largely due to increased oil production in the Elk Basin Tensleep pool.

New Mexico.—Information on gas developments in New Mexico was furnished by Foster Morrell, Federal Geological Survey.

In southeastern New Mexico, eight gas wells were drilled in Lea County and four in Eddy County in 1946, compared with six in Lea

and four in Eddy in 1945. A discovery well in Lea County opened the Justis pool, an area of undetermined importance. The well was plugged back to 4,933 feet in the Yeso formation of Permian age. Two other wells were drilled in the area in 1946.

In northwestern New Mexico, 25 wells were completed in the San Juan Basin, compared with 11 in 1945. A discovery well in the Blanco field was completed at a depth of 1,927 feet in the Farmington (Upper Cretaceous) formation. The Barker Creek dome field was established as one of the major gas fields in the State by the completion of two additional wells in the Paradox formation of Pennsylvanian age.

Two carbon-dioxide gas wells were drilled in Harding County in 1946, making a total of 12 commercial wells in that area. Three plants were in operation, and a fourth unit was under construction for making dry ice.

Natural-gas production in southeastern New Mexico increased from 108.7 million cubic feet in 1945 to 130.7 million in 1946. Natural-gasoline plants treated 110.8 million cubic feet in 1946. Residue gas from these plants was distributed as follows: domestic, commercial, and industrial markets 67.6 million, carbon black 25.7, gasoline-plant and lease fuel 10.7, vented 17.7, repressuring 2.6, and unaccounted for 6.4

In northwestern New Mexico, domestic and commercial markets took 6,396 million cubic feet in 1946, compared with 6,056 million in 1945.

New York.—John G. Broughton, Assistant State Geologist, New York State Geological and Natural History Surveys, reports only 5 successful wells out of 25 (mostly wildcats) drilled in New York in 1946. This compares with 6 out of 20 drilled in 1945. Completions were in Allegany, Steuben, Chautauqua, Cattaraugus, Tompkins, and Wyoming Counties. Their depth ranged from 1,722 feet in the northern part to 4,842 feet in the southern part of the State, and were mostly to the Oriskany sands. Three of the five producers were in the Tuscarora field, Steuben County, the best having 5,750,000-cubic feet initial daily capacity. Two completions in Chautauqua County had small flows of gas from the Medina sand. All other deep tests were unsuccessful. A deep test in Wyoming County begun in 1945 was abandoned in 1946 at 7,126 feet.

North Dakota.—A report of the North Dakota Geological Survey by Wilson M. Laird, State Geologist, indicated a 45-percent gain in natural-gas production in 1946 over 1945. Twelve wells were operated, compared with 13 in 1945. Gas is drawn from the Eagle sand and Pierre shale in Bowman County. Permits were granted to drill 15 wells in 1946, but not all have been put into production.

According to J. R. Schwabrow, Federal Geological Survey, seven gas wells and three dry holes were drilled in 1946 in the extreme southeastern end of the Cedar Creek anticline, probably defining the pool in that direction. A gross production of 345 million cubic feet was reported.

Ohio.—Information on gas developments in Ohio was supplied by K. C. Cottingham, chief geologist, Ohio Fuel Gas Co.

Gas completions increased from 429 in 1945 to 547 in 1946. Of these wells, 371 were in the Clinton sand, 88 in the Berea, 44 in the

Shallow, 21 in the Oriskany, and 23 in other sands. The largest was a Clinton well with an initial flow of 12,000,000 cubic feet from a depth of 4,604 feet. Stark County was the most active, with 139 wells drilled, followed by Muskingum with 50, Lorain with 45, and Ashland with 36. A deep test in Muskingum County found gas at 6,558–6,560 feet but was abandoned at 6,704 feet because of water.

About 4,400 acres were proved by new gas pools, compared with 7,000 in 1945. Older pools were extended approximately 17,000 acres, mostly in the Clinton field. Wells averaged 4,700 feet in depth with initial open flow of about 2,500,000 cubic feet each. Production increased from 51,724 million cubic feet in 1945 to 59 billion in 1946.

Oklahoma.—Elmer Capshaw, gas engineer, Oklahoma Corporation Commission, supplied the following information:

There were 38 wildcat wells and 333 wells drilled in old fields in Oklahoma during 1946; 94 over the 1945 record. A large number of new gas fields were discovered in the Anadarko Basin in western and northern Oklahoma, mostly in Garvin, McClain, and Grady Counties, but they have no pipe-line connections as yet. Drilling has been active in Texas County in the Hugoton field, where there are now over 400 producing wells connected to pipe lines.

Casinghead gas from the oil fields is being used more extensively than in former years. The amount of casinghead gas used in 1946 increased 15 percent over the 1945 record, and dry-gas production decreased 2 percent. A total of 403,500 million cubic feet of gas was recorded in 1946, compared with 385,900 million in 1945, an increase of about 5 percent.

Pennsylvania.—According to J. G. Montgomery, Jr., vice president, United Natural Gas Co., gas completions in the shallow-sand fields of Pennsylvania increased from 520 in 1945 to 592 in 1946.

The results of increased drilling activity emphasized the trend toward decreased productive capacity of wells. The new wells had a daily open-flow capacity of only 128,811,000 cubic feet, compared with 148,662,000 cubic feet developed in 1945. In the southwestern district the 64 million cubic feet developed was 35 percent below the 1945 level, even though completions numbered about the same.

New pools, probably of minor importance, were found in Allegheny, Fayette, Jefferson, and Potter Counties. Tests in the deep sands in 1946 were, for the most part, failures. A successful one in Georges Township, Fayette County, proved to be the largest drilled in several years in the northern Appalachian area. Its initial daily production was over 32 million cubic feet—from the Onondago chert. Two other producers were completed in the area during the year. One small producer was completed in Potter County and one in Westmoreland. An Oriskany pool was discovered in Erie County by a well having a production of 420,000 cubic feet a day with a rock pressure of 825 pounds. Other deep-sand tests in Beaver, Erie, Mercer, Westmoreland, Potter, and Crawford Counties were failures.

Additional quantities of Mid-Continent gas were made available in December 1946 through the lease of the War Emergency Pipe Line to the Tennessee Transmission & Gas Co.

South Dakota.—A report from J. R. Schwabrow, Federal Geological Survey, states that three small gas wells and four dry holes were drilled in the Ardmore area in western South Dakota in 1946.

Each well had an estimated open flow of about 250,000 cubic feet and a 35-pound pressure. Gross production from gas-water wells in the Pierre gas field was estimated at about 14 million cubic feet, of which 9 million were marketed and 5 million lost. This compares with 10 million sold in 1945.

Texas.—According to records of the Railroad Commission of Texas, gross production of natural gas in 1946 was 2,769 billion cubic feet, of which 2,102 billion were from gas and condensate wells and 667 billion from oil wells. Of the total, slightly more than 700 billion cubic feet were returned to underground reservoirs for pressure maintenance and repressuring, and 113 billion were lost or vented to the air.

Gas- and condensate-well completions declined from the extraordinary total of 714 in 1945 to 499 in 1946 owing to a reduction in Panhandle drilling from 341 gas wells in 1945 to 121 in 1946. New wells in the Carthage field increased from 92 in 1945 to 120 in 1946.

Discovery of 20 condensate-type fields was reported in 1946. Eighteen of these were in the Gulf area and two in eastern Texas. Eighteen gas fields were discovered. Four of these were in West Texas, four in Southwest, and four in Gulf districts. In 1945 and 1946, the large number of condensate and gas discoveries and extensions in the lower Gulf district have increased greatly the importance of this area as a source of these fuels for the future. Although new pipe-line construction is providing larger outlets for the gas, available supplies far exceed current needs.

A large expansion in markets for gas from eastern and Gulf Texas is being provided for the near future by the conversion of the large war-emergency pipe lines to gas use, by increased capacity of several major gas-transmission systems delivering fuel to Northern and Eastern States, and by projected new systems to serve these areas. The new line from west Texas to California is expected to provide this winter a new outlet for much gas from this district that at present is being blown to the air for lack of a buyer.

Utah.—J. R. Schwabrow, Federal Geological Survey, reported that there were no gas discoveries in Utah during 1946. The only gas completion was a deep test in the Farnham carbon-dioxide gas field, which was plugged back to the Coconino producing sand. Deep tests also were being drilled for oil or gas in the Pennsylvanian or other lower formations in the Clay Basin and South Last Chance gas fields.

Dry-ice manufacture utilized 152 million cubic feet of carbon-dioxide gas in 1946, compared with 140 million in 1945. (These figures are not included in the natural-gas statistics.)

Metered production from the Clay Basin field was 4,295 million cubic feet in 1946. In addition, 19 million were used in the field and 7 million were lost. Comparable figures for 1945 are 6,652, 18, and 1, respectively.

Virginia.—William M. McGill, assistant State geologist, Virginia Geological Survey, reported two wells drilled in the northwestern part of Rockingham County in 1946. The first encountered sulfur water at 2,570 feet and was abandoned. The second was abandoned at 2,753 feet after a slight show of gas was lost by shooting. Both reached the Oriskany sandstone. They were near the discovery

well drilled in 1941 that found about 60,000 cubic feet of gas in the Oriskany formation at 2,992 feet. There was no activity in the Early Grove area, from which present production is obtained.

West Virginia.—About 44,000 acres were added to proved gas territory in West Virginia in 1946, compared with about 58,000 in 1945. David B. Reger, consulting geologist, Morgantown, W. Va., reports that five gas pools were discovered during the year, or late in 1945, and that successful wildcats indicate additional areas to be proved in 1947.

Drilling activity centered in Wyoming County and led to new discoveries in that area. The discovery of Lower Devonian gas in the outer boundaries of the Charleston pool and in sharp mountain anticlines east and southeast of older producing areas was of special interest. The discovery of a new pool by a small Oriskany well and a large Huntersville well on a sharp mountain anticline in Preston County leads to the supposition that deep drilling may be profitable on many similar structures.

Of 33 wildcats drilled, 21 discovered gas. Total gas completions declined from 499 in 1945 to 467 in 1946. Forty-four old wells added 36,561 cubic feet daily to production when deepened. Counties of greatest activity and wells drilled were: Lincoln, 55; Wyoming, 51; Kanawha, 33; Wayne, 32; Putnam, 28; and Jackson, 25. Fifty Oriskany-sand completions drilled in 1946 were located as follows: Jackson County, 24; Kanawha, 25; and Putnam, 1.

The practice of a number of utilities of storing gas in depleted pools near large consuming centers was continued during the year. Increasing quantities of Texas gas were received, most of which was transported to Ohio, New York, and Pennsylvania. Production was estimated at 175 billion cubic feet in 1946, compared with 160,225 million in 1945.

Wyoming.—J. R. Schwabrow, Federal Geological Survey, reported 13 gas completions in Wyoming in 1946, as in 1945. Total open-flow capacity of new wells was 131,694,000 cubic feet in 1946 and 80,000,000 in 1945. The deepest well drilled, 12,887 feet, in 1946 had the deepest production in the Rocky Mountain region. It is thought to have opened a large condensate field—the Church Buttes. Two other wells were being drilled in the field at the end of the year. Other discoveries were the Table Rock field and a stray showing at South Douglas. A well drilled in the South Sand Draw either extended the Big Sand Draw or discovered a separate pool about a mile southeast of that area.

Carbon-dioxide gas was discovered in the Tensleep or Weber sandstone by a well at North Baxter Basin. It was plugged back to the Nugget sand and shut in. Litigation is pending to decide whether it should be called a gas or an oil well. Wells completed in proved acreage were Beaver Creek (2), North Baxter Basin (2), and one each in South Elk Basin, Middle Baxter Basin, Big Polecat, and Oil Springs.

Fields producing over a billion cubic feet in 1946 were Baxter Basin, 7,175 million; Big Sand Draw, 4,797; Garland, 3,125; Lance Creek, 2,987; Salt Creek, 2,749; Beaver Creek, 2,386; Little Buffalo Basin, 2,105; Oil Springs, 1,398; Elk Basin, 1,388; Hiawatha (Wyoming), 1,159; and Muskrat, 1,151. Baxter Basin field accounted for

14 percent of the State's output in 1946, compared with 19 percent in 1945. Oil Springs was added to the list of large producing areas.

Metered production declined 7 percent, from 36,357 million cubic feet in 1945 to 33,979 million in 1946. This decrease may be attributed partly to reduced industrial activity. Gross production was 49,725 million cubic feet, compared with 51,673 in 1945. Gas returned to the sands in eight fields totaled 11,847 million cubic feet in 1946, 11,736 million in 1945. Field use accounted for 1,083 million cubic feet in 1946 and 2,816 million were lost.

INTERSTATE SHIPMENTS AND EXPORTS

The interstate and export movement of natural gas increased 7 percent over 1944, to 1,105,760 million cubic feet in 1945, equal to 28 percent of total marketed production of the United States. Shipments from Texas and Oklahoma increased notably as new facilities for long-distance gas transmission to northern and eastern markets came into full use. Among other important "exporting" States, material declines were indicated for Kansas, Louisiana, West Virginia, and Kentucky. Operations in Louisiana were influenced by the State government policy of discouraging shipments to other States in which adequate supplies of other fuels were available. Gas shipments from the other three States were curtailed in some degree probably because of the larger supplies made available to their market areas of gas from Texas and Oklahoma.

States consuming the largest amounts of gas from outside sources in 1945, with the quantities involved in billions of cubic feet, were Ohio, 124.0; Illinois, 104.8; Kansas, 94.4; Pennsylvania, 92.1; and Missouri, 72.0.

Exports of gas to Mexico reached a new high of 18,016 million cubic feet in 1945, compared with 14,433 million in 1944.

Interstate transportation of natural gas in 1945 [1]

Producing State	Transit State	Consuming State [1]	Millions of cubic feet
Arkansas		Louisiana	833
Colorado	Wyoming	Utah	3,907
		Wyoming	5
Illinois		Indiana	3,912
Indiana			53
		Illinois	19
		Kentucky	57
			76
Kansas	Missouri	Colorado	987
	do	Illinois	3,734
	Illinois	Indiana	6,190
	Nebraska	Iowa	8,906
	do	do	47
	South Dakota		
	Missouri	Kentucky	247
	Illinois		
	Indiana		

[1] Includes exports to Canada and Mexico.

Interstate transportation of natural gas in 1945 [1]—Continued

Producing State	Transit State	Consuming State [1]	Millions of cubic feet
Kansas—Continued	Missouri, Illinois, Indiana, Ohio	Michigan	10,200
	Nebraska, Iowa	Minnesota	16,288
		Missouri	7,745
		Nebraska	14,996
	Nebraska, Iowa	do	3
	Missouri, Illinois, Indiana	Ohio	7,821
		Oklahoma	908
	Nebraska	South Dakota	1,851
			79,923
Kentucky	West Virginia, Virginia, Maryland	District of Columbia	6,883
		Indiana	220
	West Virginia, Virginia	Maryland	153
	West Virginia, Virginia, Maryland, District of Columbia	do	1,368
		Ohio	6,307
	West Virginia	do	8,754
	do	Pennsylvania	20,183
	do	do	1,999
	Virginia, Maryland, West Virginia	Virginia	222
	do	do	801
	Virginia, Maryland, District of Columbia	West Virginia	17,120
			64,010
Louisiana	Mississippi	Alabama	39,636
		Arkansas	34,955
	Mississippi, Alabama	Florida	7,320
	Mississippi, Alabama	Georgia	30,934
	Arkansas, Missouri	Illinois	19,941
		Mississippi	28,028
	Arkansas	do	3,799
	do	Missouri	21,257
	do, Mississippi	Tennessee	23,579
		Texas	19,269
			228,718
Mississippi		Alabama	32
	Alabama	Florida	5
			37
Montana		North Dakota	2,640
	North Dakota	South Dakota	2,860
			5,500
New Mexico	Texas, New Mexico	Arizona	22,488
		Colorado	343
	Texas, New Mexico, Arizona	Mexico	3,281
		Texas	9,505
			35,617

[1] Includes exports to Canada and Mexico.

Interstate transportation of natural gas in 1945 [1]—Continued

Producing State	Transit State	Consuming State [1]	Millions of cubic feet
New York		Canada	31
		Pennsylvania	3,601
			3,632
North Dakota	Montana	South Dakota	217
	North Dakota		
Ohio		West Virginia	1,679
Oklahoma		Arkansas	4,612
	Kansas	Illinois	2,402
	Missouri		
	Kansas	Indiana	3,985
	Missouri		
	Illinois		
	Kansas	Iowa	118
	Nebraska		
		Kansas	57,984
	Kansas	Kentucky	157
	Missouri		
	Illinois		
	Indiana		
	Kansas	Michigan	6,541
	Missouri		
	Illinois		
	Indiana		
	Ohio		
	Kansas	Minnesota	213
	Nebraska		
	Iowa		
	Kansas	Missouri	25,740
	do	Nebraska	819
	do	Ohio	5,030
	Missouri		
	Illinois		
	Indiana		
	Kansas	South Dakota	24
	Nebraska		
		Texas	14,409
			122,034
Pennsylvania	New York	Canada	160
		Maryland	556
		New York	23,999
		Ohio	103
		West Virginia	377
			25,195
Texas	Louisiana	Alabama	3,749
	Mississippi		
	Louisiana	Arkansas	5,864
	New Mexico	Colorado	32,545
	Louisiana	Georgia	4,981
	Mississippi		
	Alabama		
	Oklahoma	Illinois	7,592
	Kansas		
	Missouri		
	Oklahoma	do	71,068
	Kansas		
	Nebraska		
	Iowa		
	Oklahoma	Indiana	12,584
	Kansas		
	Missouri		
	Illinois		
	Oklahoma	do	15,775
	Kansas		
	Nebraska		
	Iowa		
	Illinois		
	Oklahoma	Iowa	18,667
	Kansas		
	Nebraska		
	Oklahoma	do	56
	Kansas		
	Nebraska		
	South Dakota		

[1] Includes exports to Canada and Mexico.

Interstate transportation of natural gas in 1945 [1]—Continued

Producing State	Transit State	Consuming State [1]	Millions of cubic feet
Texas—Continued	Oklahoma	Kansas	36,386
	Louisiana, Arkansas, Mississippi, Tennessee	Kentucky	5,186
	Oklahoma, Kansas, Missouri, Illinois, Indiana	do	503
		Louisiana	10,984
	Louisiana, Arkansas, Mississippi, Tennessee, Kentucky, West Virginia	Maryland	172
		Mexico	14,735
	Oklahoma, Kansas, Missouri, Illinois, Indiana, Ohio	Michigan	20,901
	Oklahoma, Kansas, Nebraska, Iowa, Illinois, Indiana	do	78
	Oklahoma, Kansas, Nebraska, Iowa	Minnesota	19,429
	Louisiana	Mississippi	1,021
	do	do	899
	Arkansas	Missouri	17,227
	Oklahoma, Kansas	Nebraska	10,830
	Oklahoma, Kansas, Nebraska, Iowa	do	4
		New Mexico	2,053
	Louisiana, Arkansas, Mississippi, Tennessee, Kentucky, West Virginia	Ohio	22,804
	Oklahoma, Kansas, Missouri, Illinois, Indiana	do	16,156
		Oklahoma	13,523
	Louisiana, Arkansas, Mississippi, Tennessee, Kentucky, West Virginia	Pennsylvania	13,844
	Oklahoma, Kansas, Nebraska	South Dakota	2,201
	Louisiana, Arkansas, Mississippi	Tennessee	809
	Louisiana, Arkansas, Mississippi, Tennessee, Kentucky, West Virginia	Virginia	248

[1] Includes exports to Canada and Mexico.

Interstate transportation of natural gas in 1945 [1]—Continued

Producing state	Transit State	Consuming State [1]	Millions of cubic feet
Texas—Continued	Louisiana, Arkansas, Mississippi, Tennessee, Kentucky	West Virginia	22,591
	New Mexico, Colorado	Wyoming	979
			406,444
Virginia		Tennessee	21
West Virginia		Kentucky	2,948
		Maryland	335
		Ohio	55,396
	Kentucky	do	1,599
		Pennsylvania	52,130
	Maryland	do	342
		Virginia	485
			113,235
Wyoming		Montana	3,246
		Nebraska	1,583
		Utah	9,795
			14,624
Total United States			1,105,760

[1] Includes exports to Canada and Mexico.

PIPE-LINE DEVELOPMENTS

Although the mileage of new gas-transmission lines completed and placed in service in 1946 was less than in several previous years, a major expansion in capacity of the industry was indicated by projects in the course of construction and for which Federal Power Commission approvals had been obtained or applied for.

Progress was retarded by scarcity of materials, particularly large-diameter pipe, for which demand is expected to exceed the prospective supply for several years. Further large expansion of capacity of major transmission systems was completed or in progress to bring natural gas from the Hugoton-Panhandle field to Detroit, Minneapolis, Kansas City, and Chicago, and from Louisiana-Texas Gulf fields to St. Louis and the Appalachian region.

The largest new system on which construction was begun in 1946 was a 26- and 30-inch line to transport gas from west Texas and the Texas Panhandle to southern California, with a projected capacity of 305 million cubic feet daily. Several important lines were laid in south and east Texas and in Mississippi to connect additional gas reserves to pipe-line outlets.

In California, a pipe line from Kettleman Hills to the San Francisco Bay region, which had been converted from gas to oil as a war emergency measure, was reconverted for use as a gas line. Several gas fields in the northern district were provided with pipe-line outlets for the first time.

To alleviate a fuel shortage in the northeastern industrial region, the war emergency pipe lines "Big Inch" and "Little Big Inch" were placed in gas service in December 1946 under a temporary lease to

Tennessee Gas & Transmission Co. extending through April 30, 1947. These lines were sold in early 1947 to a new company, Texas Eastern Transmission Corp., which plans to become an important supplier of natural gas to markets from Indiana to New England.

In addition to projects already approved, applications on file with the Federal Power Commission on April 1, 1947, involved a proposed investment of approximately $825,000,000 in facilities for transportation of natural gas.

CONSUMPTION

Consumption of natural gas in the United States in 1945 amounted to 3,900,479 million cubic feet, compared with 3,696,463 million in 1944. All major classes of consumers except miscellaneous industrial contributed to the increase in demand. Measures to restrict consumption during cold periods of peak demand were again required in the Appalachian and other market areas that are dependent for supplies of gas, at least in part, on remote sources.

Domestic and commercial consumers used 8 and 4 percent, respectively, more gas in 1945 than in 1944, and industrial consumers 5 percent more, chiefly because of larger requirements for oil- and gas-field activities and for carbon-black manufacture.

Natural gas consumed in the United States, 1941–45

Year	Domestic and commercial consumption							
	Consumers (thousands)[1]			Billions of cubic feet			Average M cubic feet used per consumer	Average value at point of consumption (cents per M)
	Domestic	Commercial	Total	Domestic	Commercial	Total		
1941	9,730	767	10,497	442	145	587	55.9	65.9
1942	10,135	779	10,914	498	184	682	62.5	63.4
1943	10,354	811	11,165	529	205	734	65.8	62.4
1944	10,669	845	11,514	562	221	783	68.0	61.4
1945	10,959	889	11,848	607	230	837	70.7	61.2

Year	Industrial consumption							Total consumption		Electric public utility power plants (billions of cubic feet)[2]
	Billions of cubic feet						Average value at point of consumption (cents per M)	Billions of cubic feet	Average value at point of consumption (cents per M)	
	Field	Carbon-black manufacture	Petroleum refineries	Portland-cement plants	Other industrial	Total industrial				
1941	686	365	148	54	965	2,218	10.5	2,805	22.1	205
1942	721	336	202	64	1,040	2,363	10.9	3,045	22.7	239
1943	781	315	244	52	1,277	2,669	11.3	3,403	22.3	306
1944	855	356	[3] 315	35	[3] 1,352	2,913	10.8	3,696	21.5	360
1945	917	432	339	38	1,337	3,063	10.5	3,900	21.4	326

[1] Includes consumers served with mixed gas.
[2] Federal Power Commission. Figures include gas other than natural (impossible to segregate) therefore shown separately from other consumption.
[3] Revised.

Natural gas consumed in the United States, 1941–45, by States, in millions of cubic feet

State	1941	1942	1943	1944	1945
Alabama	32,023	36,287	40,123	44,323	43,417
Arizona	18,213	24,783	24,048	23,908	22,488
Arkansas	46,933	54,069	82,825	94,783	91,198
California	374,905	403,968	457,757	502,017	502,442
Colorado	26,574	28,860	31,424	33,101	34,877
District of Columbia	5,124	5,966	6,754	6,782	6,883
Florida	2,378	3,303	4,033	6,545	7,331
Georgia	23,975	31,996	33,280	35,603	35,915
Illinois	98,634	110,941	122,340	123,325	121,366
Indiana	29,989	37,642	39,227	38,581	40,274
Iowa	24,589	29,481	28,687	27,307	27,794
Kansas	109,059	121,354	129,173	143,814	160,406
Kentucky	20,170	21,382	23,409	24,399	26,802
Louisiana	222,025	253,894	290,651	310,127	325,888
Maryland	6,587	7,438	2,395	2,491	2,584
Michigan	37,290	42,202	53,010	56,077	59,594
Minnesota	22,672	29,116	33,501	35,229	35,930
Mississippi	20,813	26,444	30,113	33,111	38,297
Missouri	58,138	61,354	59,577	65,046	72,059
Montana	24,751	27,773	28,815	29,019	29,575
Nebraska	19,205	20,730	20,462	24,699	28,235
New Mexico	39,138	45,822	52,126	55,284	71,459
New York	25,384	27,150	27,787	27,057	29,577
North Dakota	1,741	1,904	2,030	2,267	2,640
Ohio	136,251	144,325	162,371	166,785	172,258
Oklahoma	209,395	220,991	230,423	249,996	249,927
Pennsylvania	139,492	143,187	159,004	148,675	149,092
South Dakota	6,580	7,611	7,483	7,688	7,158
Tennessee	22,495	22,806	24,252	24,693	24,419
Texas	875,620	917,657	1,059,329	1,221,383	1,348,140
Utah	16,667	18,920	20,303	20,275	20,264
Virginia	1,166	1,418	1,610	1,694	1,791
Washington	1				
West Virginia	88,597	93,365	94,315	88,953	88,757
Wyoming	18,618	20,634	20,842	21,426	21,642
Total United States	2,805,192	3,044,773	3,403,479	3,696,463	3,900,479

Treated for Natural Gasoline.—The volume of natural gas processed at natural-gasoline and cycle plants increased 11 percent in 1945 to a record of 3,653,870 million cubic feet, equal to 94 percent of total consumption. Since 1941, the gas throughput at plants has increased 32 percent. States reporting the largest gains in this period were Texas, Louisiana, California, and Arkansas, in all of which the processing of high-pressure gas from deep reservoirs of the condensate type is an important factor. Moderate declines in gas processing in the same period were general in the eastern producing States, in Kansas (where crude oil was produced at declining rates for several years), and in Oklahoma.

Domestic and Commercial.—The 8-percent increase in use of natural gas for household purposes in 1945 to 607,400 million cubic feet was accompanied by a gain of 3 percent in the number of meters connected to lines and an expansion in the indicated average gas use per meter from 52,700 cubic feet in 1944 to 55,400 cubic feet in 1945 (5 percent). An average of 341,266 domestic meters have been added (net) annually during the past 7 years to the systems of utilities distributing natural and mixed (natural and manufactured) gas. In the same period, the consumption per meter increased at the average rate of 1,786 cubic feet yearly.

Commercial consumption amounted to 230,099 million cubic feet in 1945, a gain of 4 percent over 1944. Commercial meters were 5 percent more numerous in 1945, but consumption per meter declined to 258,900 cubic feet from 261,200 cubic feet (1 percent) in 1944.

Natural gas treated at natural-gasoline and cycle plants in the United States, 1941–45, by States, in millions of cubic feet

State	1941	1942	1943	1944 [1]	1945
Arkansas	19,906	25,365	43,309	53,539	55,725
California	371,350	345,191	349,383	397,860	420,482
Colorado	134	25			
Illinois	23,732	25,722	32,200	32,000	27,690
Kansas	176,088	179,710	196,043	158,524	165,538
Kentucky	38,062	35,408	46,149	48,746	41,562
Louisiana	191,194	247,370	236,286	307,912	310,614
Michigan	3,581	1,418	835	3,330	4,271
Montana	10,386	11,728	11,950	11,630	12,000
New Mexico	105,161	108,911	94,194	103,277	116,539
New York	5	4	4	4	3
Ohio	37,546	39,851	39,106	40,482	35,210
Oklahoma	200,319	202,653	188,029	191,610	193,744
Pennsylvania	43,704	46,603	53,616	53,672	42,565
Texas	1,325,471	1,372,563	1,520,043	1,682,738	2,039,983
West Virginia	195,093	197,643	198,636	195,000	166,037
Wyoming	21,568	24,235	18,217	19,676	21,907
Total	2,763,300	2,864,400	3,028,000	3,300,000	3,653,870
Ratio to total consumption	.99	.94	.89	.89	.94

[1] Partly estimated.

Field.—Gas consumed in field operations of the oil and gas industry increased 7 percent in 1945 to 916,952 million cubic feet. The principal gains were in Texas, Louisiana, California, New Mexico, and Arkansas, in all of which production of the natural-gasoline industry increased. A decline of 4.8 billion cubic feet in Oklahoma field-gas consumption was accompanied by a decline of 5 million gallons in output of natural-gas liquids.

Carbon Black Manufacture.—A record total of 431,830 million cubic feet of natural gas was used for manufacture of carbon black in 1945, compared with 355,770 million in 1944. The average value of gas at the plants increased from 1.6 cents a thousand cubic feet in 1944 to 2.3 cents in 1945 and 3.0 cents in 1946. The yield of carbon black per thousand cubic feet of gas consumed has increased progressively from 1.63 pounds in 1941 to 2.32 pounds in 1945, influenced by growing use of the high-yield furnace processes. The scarcity of cheap sources of dry gas in recent years has stimulated a larger use at carbon-black plants of casinghead gas from natural-gasoline plants.

Petroleum Refineries.—An increase of 7 percent over 1944 to 338,458 million cubic feet in 1945 was reported in use of natural gas as fuel at petroleum refineries, compared with an increase of 3 percent in crude oil processed at refineries. The principal gains in gas use, in billions of cubic feet, were in Texas, 14.1; California, 12.1; Kansas, 3.7; and Louisiana, 3.6.

Electric Public-Utility Power Plants.—Gas consumption at electric-power plants in 1945 was reduced 9 percent below the 1944 peak, to 326,190 million cubic feet, according to the Federal Power Commission, whose data include a small quantity of manufactured gas with the natural gas. The largest decline in use, 21.6 billion cubic feet, was reported in California as a result of a shift to fuel oil as the source of energy at generating plants in the central part of the State. Minor declines in Texas, Oklahoma, Louisiana, and many other States were related to the temporary shrinkage in business activity following the end of hostilities in August 1945. Among scattered small gains, the largest, 3.9 billion cubic feet, was in Missouri.

Domestic and commercial consumption of natural gas in the United States in 1945, by States [1]

State	Domestic				Commercial				Total			
	Consumers	Quantity (millions of cubic feet)	Value at point of consumption		Consumers	Quantity (millions of cubic feet)	Value at point of consumption		Consumers	Quantity (millions of cubic feet)	Value at point of consumption	
			Total (thousands of dollars)	Average (cents per M)			Total (thousands of dollars)	Average (cents per M)			Total (thousands of dollars)	Average (cents per M)
Alabama	51,030	3,277	2,354	71.8	4,960	1,426	654	45.9	55,990	4,703	3,008	64.0
Arizona	52,630	2,584	2,204	85.3	6,040	2,552	932	36.5	58,670	5,136	3,136	61.1
Arkansas	96,220	9,239	4,387	47.5	15,930	5,152	1,785	34.6	112,150	14,391	6,172	42.9
California	1,967,060	115,944	77,064	66.5	168,840	56,492	22,026	39.0	2,135,900	172,436	99,090	57.5
Colorado	115,540	9,255	6,515	70.4	12,940	3,102	1,555	50.1	128,480	12,357	8,070	65.3
District of Columbia	[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]
Florida	7,380	367	392	106.8	710	170	92	54.1	8,090	537	484	90.1
Georgia	106,110	7,305	6,084	83.3	8,870	4,296	1,595	37.1	114,980	11,601	7,679	66.2
Illinois	1,364,100	25,432	29,223	114.9	72,110	6,682	5,201	77.8	1,436,210	32,114	34,424	107.2
Indiana	236,660	6,667	8,188	122.8	13,920	1,938	1,637	84.5	250,580	8,605	9,825	114.2
Iowa	158,400	6,582	5,764	87.6	13,860	2,465	1,454	59.0	172,260	9,047	7,218	79.8
Kansas	264,090	25,148	14,687	58.4	32,210	12,501	3,963	31.7	296,300	37,649	18,650	49.5
Kentucky	197,920	12,356	7,059	57.1	19,470	3,863	1,795	46.5	217,390	16,219	8,854	54.6
Louisiana	254,970	14,437	8,768	60.7	26,660	8,896	2,714	30.5	281,630	23,333	11,482	49.2
Maryland	[2] 241,580	[2] 8,038	[2] 6,300	[2] 78.4	[2] 15,970	[2] 1,871	[2] 1,232	[2] 65.8	[2] 257,550	[2] 9,909	[2] 7,532	[2] 76.0
Michigan	905,320	32,342	31,578	97.6	38,450	5,262	4,317	82.0	943,770	37,604	35,895	95.5
Minnesota	182,740	9,073	6,256	69.0	8,210	2,579	1,042	40.4	190,950	11,652	7,298	62.6
Mississippi	70,210	5,165	3,608	69.9	10,730	4,447	1,544	34.7	80,940	9,612	5,152	53.6
Missouri	456,990	20,661	17,737	85.8	30,570	4,183	2,396	57.3	487,560	24,844	20,133	81.0
Montana	51,110	8,547	3,966	46.4	5,100	5,101	1,534	30.1	56,210	13,648	5,500	40.3
Nebraska	137,640	8,120	5,599	69.0	12,360	2,842	1,363	48.0	150,000	10,962	6,962	63.5
New Mexico	39,870	3,576	2,380	66.6	5,160	3,438	1,113	32.4	45,030	7,014	3,493	49.8
New York	437,180	19,875	15,890	79.9	37,030	3,961	2,743	69.3	474,210	23,836	18,633	78.2
North Dakota	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]
Ohio	1,339,810	86,124	54,259	63.0	112,250	18,126	10,211	56.3	1,452,060	104,250	64,470	61.8
Oklahoma	307,590	29,975	13,707	45.7	36,470	18,024	4,848	26.9	344,060	47,999	18,555	38.7
Pennsylvania	705,140	46,473	29,681	63.9	47,760	9,206	4,872	52.9	752,900	55,679	34,553	62.1
South Dakota	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]	[3]
Tennessee	61,940	5,233	3,731	71.3	8,470	4,683	1,657	35.4	70,410	9,916	5,388	54.3
Texas	844,010	50,775	32,514	64.0	95,310	26,090	9,602	36.8	939,320	76,865	42,116	54.8
Utah	[3] 65,230	[3] 6,103	[3] 4,437	[3] 72.7	[3] 4,310	[3] 3,061	[3] 1,136	[3] 37.1	[3] 69,540	[3] 9,164	[3] 5,573	[3] 60.8
Virginia	[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]
West Virginia	214,540	24,272	8,677	35.7	20,190	5,151	1,749	34.0	234,730	29,423	10,426	35.4
Wyoming	26,050	4,455	2,113	47.4	3,800	2,539	810	31.9	29,850	6,994	2,923	41.8
Total: 1945	10,959,060	607,400	415,122	68.3	888,660	230,099	97,572	42.4	11,847,720	837,499	512,694	61.2
1944	10,668,400	562,183	388,359	69.1	845,220	220,747	92,137	41.7	11,513,620	782,930	480,496	61.4

[1] Includes natural gas used with manufactured gas. [2] Maryland includes District of Columbia and Virginia. [3] Utah includes North Dakota and South Dakota.

Industrial consumption of natural gas in the United States in 1945 by States and uses

State	Field (drilling, pumping, and operating gasoline-recovery plants)		Carbon-black manufacture			Fuel at petroleum refineries, electric public-utility power plants, cement plants, and other industrial						Total industrial			Fuel at electric public-utility power plants [1] (millions of cubic feet)
				Value at point of consumption		Millions of cubic feet				Value at point of consumption			Value at point of consumption		
	Millions of cubic feet (estimated)	Value at point of consumption (estimated; thousands of dollars)	Millions of cubic feet	Total (thousands of dollars)	Average (cents per M)	Petroleum refineries	Portland cement plants	Other industrial	Total	Total (thousands of dollars)	Average (cents per M)	Millions of cubic feet	Total (thousands of dollars)	Average (cents per M)	
Alabama							(2)	[2] 38,714	38,714	6,467	16.7	38,714	6,467	16.7	6,557
Arizona								17,352	17,352	3,529	20.3	17,352	3,529	20.3	2,091
Arkansas	19,332	929				8,205	(2)	[2] 49,270	57,475	4,959	13.2	76,807	5,888	7.7	7,727
California	136,159	8,839	(3)	(3)	(3)	64,101	9,629	[3] 120,117	[3] 193,847	[3] 28,312	[3] 14.6	330,006	37,151	11.3	35,097
Colorado	745	114				1	(2)	[2] 21,774	21,775	3,236	14.9	22,520	3,350	14.9	5,375
District of Columbia								(4)	(4)	(4)	(4)	(4)	(4)	(4)	
Florida	6	(5)						6,788	6,788	948	14.0	6,794	948	14.0	2,620
Georgia								24,314	24,314	4,480	18.4	24,314	4,480	18.4	13,707
Illinois	15,544	838				401		73,307	73,708	17,379	23.6	89,252	18,217	20.4	1,657
Indiana	343	35				648		30,678	31,326	8,883	28.4	31,669	8,918	28.2	3,968
Iowa							(2)	[2] 18,747	18,747	3,240	17.3	18,747	3,240	17.3	5,975
Kansas	18,471	1,050	(3)	(3)	(3)	10,561	5,012	[3] 88,713	[3] 104,286	[3] 11,641	[3] 11.2	122,757	12,691	10.3	26,089
Kentucky	2,358	364				66		8,159	8,225	2,334	28.4	10,583	2,698	25.5	
Louisiana	93,880	3,903	23,209	631	2.7	53,029	(2)	[2] 132,437	185,466	17,771	9.6	302,555	22,305	7.4	42,516
Maryland								[4] 1,349	[4] 1,349	[4] 738	[4] 54.7	[4] 1,349	[4] 738	[4] 54.7	
Michigan	1,782	240				53		20,155	20,208	9,596	47.5	21,990	9,836	44.7	14
Minnesota								24,278	24,278	4,406	18.1	24,278	4,406	18.1	6,681
Mississippi	5,003	459						23,682	23,682	3,381	14.3	28,685	3,840	13.4	3,288
Missouri	46	4					(2)	[2] 47,169	47,169	8,981	19.0	47,215	8,985	19.0	14,714
Montana	1,674	87				2,151		12,102	14,253	1,966	13.8	15,927	2,053	12.9	1,191
Nebraska						9	(2)	[2] 17,264	17,273	2,983	17.3	17,273	2,983	17.3	3,865
New Mexico	29,571	530	(3)	(3)	(3)	2,542		[3] 32,332	[3] 34,874	[3] 2,843	[3] 8.2	64,445	3,373	5.2	6,685
New York	98	25				29		5,614	5,643	3,146	55.8	5,741	3,171	55.2	839
North Dakota								(6)	(6)	(6)	(6)	(6)	(6)	(6)	234
Ohio	1,166	261				1	(2)	[2] 66,841	66,842	26,308	39.4	68,008	26,569	39.1	314
Oklahoma	111,009	4,347	8,170	327	4.0	23,034	(2)	[2] 59,715	82,749	8,257	10.0	201,928	12,931	6.4	22,296
Pennsylvania	5,753	1,701				660		87,000	87,660	29,165	33.3	93,413	30,866	33.0	12
South Dakota								(6)	(6)	(6)	(6)	(6)	(6)	(6)	2,141
Tennessee								14,503	14,503	2,189	15.1	14,503	2,189	15.1	4,416
Texas	453,207	13,586	371,717	7,857	2.1	167,034	10,817	268,500	446,351	40,505	9.1	1,271,275	61,948	4.9	104,147
Utah						992	(2)	[2] [6] 19,906	[6] 20,898	[6] 3,205	[6] 15.3	[6] 20,898	[6] 3,205	[6] 15.3	35
Virginia								(4)	(4)	(4)	(4)	(4)	(4)	(4)	
West Virginia	12,690	2,437				1,001		45,643	46,644	11,001	23.6	59,334	13,438	22.6	1,607
Wyoming	8,115	341				3,940		2,593	6,533	747	11.4	14,648	1,088	7.4	332
Unclassified by States			[3] 28,734	[3] 1,039	[3] 3.6	[2] 12,891									
Total: 1945	916,952	40,090	431,830	9,854	2.3	338,458	38,349	1,337,391	1,714,198	271,557	15.8	3,062,980	321,501	10.5	326,190
1944	855,180	36,868	355,770	5,763	1.6	[7] 315,311	35,588	[7] 1,351,684	1,702,583	271,144	15.9	2,913,533	313,775	10.8	359,745

[1] Federal Power Commission. These figures include natural and manufactured gas. However, Bureau of Mines figures on consumption of gas by electric public-utility power plants (combined with other industries under "Other industrial") comprise only natural gas.

[2] Gas used in portland-cement plants included under "Unclassified by States" for United States total and under "Other industrial" for State total to avoid disclosing figures of individual operators.

[3] Gas used in carbon-black manufacture included under "Unclassified by States" for United States total and under "Other industrial" for State total to avoid disclosing figures of individual operators.

[4] Maryland includes District of Columbia and Virginia.

[5] Less than $500.

[6] Utah includes North Dakota and South Dakota.

[7] Revised.

Portland-Cement Plants.—A recovery in cement production from the very low levels of 1944 caused an increase of 8 percent in natural-gas consumption in 1945, to 38,349 million cubic feet. Preliminary reports indicate a further sharp gain in natural-gas consumption in 1946 coincident with increased cement production.

Other Industrial.—The decline in natural-gas use by miscellaneous industrial plants from the revised total of 1,351,684 million cubic feet in 1944 to 1,337,391 million in 1945 was less than the decline in consumption by electric-power plants. Therefore, adjusting for this factor, the general industrial consumption of gas was slightly higher in 1945 than in 1944. Principal declines were in California, Arkansas, and Illinois, and gains were in New Mexico, Kansas, Texas, and Missouri.

Mixed Gas.—The volume of natural gas sold in mixtures with manufactured gas totaled 95,284 million cubic feet in 1945, compared with 89,645 million in 1944. The principal growth was in domestic sales. Industrial consumption declined about 2 percent. It is a relatively small factor in these sales because of the high unit prices prevailing in most areas where mixed gas is distributed.

Illinois and New York States are the largest factors in mixed-gas sales because of extensive marketing in the Chicago and Buffalo districts.

Consumption of natural gas used with manufactured gas in the United States in 1945, by States

State	Domestic		Commercial		Industrial (millions of cubic feet)	Total	
	Consumers	Millions of cubic feet	Consumers	Millions of cubic feet		Millions of cubic feet	Value at point of consumption (thousands of dollars)
District of Columbia	154,310	4,968	11,580	1,178	622	6,768	4,726
Illinois	1,099,040	19,103	53,340	4,976	8,616	32,695	27,455
Indiana	50,060	1,422	2,120	344	1,237	3,003	2,807
Iowa	64,400	1,484	4,810	545	272	2,301	1,882
Kentucky	85,830	3,966	7,910	1,835	1,336	7,137	3,810
Maryland	30,250	1,180	790	78	88	1,346	1,139
Michigan	6,680	61	310	11	23	95	110
Minnesota	148,980	6,091	5,070	509	656	7,256	4,914
Missouri	268,670	6,055	11,170	1,057	801	7,913	7,736
Nebraska	59,460	1,687	390	83	223	1,993	1,163
New York	292,720	10,233	16,370	1,638	1,445	13,316	10,057
Ohio	170,700	4,139	15,590	1,612	1,648	7,399	4,347
Pennsylvania	42,470	2,292	2,700	404	521	3,217	1,951
Tennessee	1,150	12	90	8	1	21	26
Virginia	30,770	604	1,460	184	36	824	765
Total: 1945	2,505,490	63,297	133,700	14,462	17,525	95,284	72,888
1944	2,478,960	58,009	131,200	13,827	17,809	89,645	68,725

TECHNOLOGIC DEVELOPMENTS

The experimental installation at main-line stations of large centrifugal compressors driven by electric motors, instead of the conventional reciprocating type, is planned by at least two major gas-transmission systems. If successful from technical and economic standpoints, this

new equipment may have an important place in new gas-moving installations.

After several years of service testing, gas-operated equipment for year-round air conditioning was actively promoted on a commercial scale in 1946 by a number of utility companies as a builder of gas markets. By its use in the warmer sections of the United States, the summer gas load for domestic and some commercial purposes may be maintained at a level comparable with that of the winter load.

A new departure in underground storage of natural gas was announced by a northern Illinois utility company, using a number of parallel sections of large-diameter pipe installed a few feet underground and filled with gas at a pressure of about 2,250 pounds per square inch. It is indicated that gas may be stored by this means near points of consumption at lower initial costs for equipment, operating, and maintenance expense than are required for gas holders of the types in common use.

Experience with large-diameter gas transmission lines carrying very great quantities of gas at high pressures has demonstrated the inadequacies of pipe-line flow formulas for measuring accurately such gas movements. Therefore, a cooperative research project was begun in 1946 by the Bureau of Mines and the American Gas Association to develop new data and formulas to satisfy the requirements of modern engineering practice.

Natural Gasoline

and Liquefied Petroleum Gases[1]

By F. S. LOTT AND A. T. COUMBE[2]

	PAGE		PAGE
General summary	835	Market demand—shipments	845
Outlook	836	Sales of liquefied petroleum gases	849
Reserves	838	Stocks	853
Production	839	Prices	854
Review by States	842	Foreign trade	855
Yields, processes, and number of plants	843		

GENERAL SUMMARY

RECORD demand for its products in the second half of the year raised operations of the natural gasoline industry in 1946 to new heights. Total production of 4,836,412 thousand gallons of light products exceeded the 1945 peak by 3 percent. In the first 6 months of 1946, production—influenced by low market prices and indifferent demand—was below the comparable 1945 period. In the late summer and fall demand for major products revived dramatically, outstripping production at increasing rates to cause rapid depletion of stocks at plants. These trends were foreshadowed by firmer spot prices in the late spring and summer and caused pronounced market strength as they became generally apparent. The price of 26–70 grade natural gasoline, f. o. b. Breckenridge, Tex., advanced from a February-April low of 2.25 cents a gallon to close the year at 4.50 cents. The Mid-Continent (Group 3) price of this product followed similar trends, averaging 3.84 cents a gallon in 1946 and 4.56 cents in 1945.

Because of the depressed prices prevailing in the first half of 1946, the total value of products at the plants declined to $179,000,000 from the 1945 total of $187,564,000. Average value per gallon was 3.7 cents in 1946 and 4.0 cents in 1945. Liquefied petroleum gases represented 20 percent of the value of light products at the plants in 1946, contrasted with 11 percent in 1941.

An increase in total stocks during 1946 from 181,513 thousand gallons to 209,209 thousand gallons resulted from a gain of 34 million gallons at plants and terminals and a 6-million gallon decline in stocks at refineries. Texas stocks accounted for a large part of these changes.

A total of 3,739 billion cubic feet of natural gas was processed in 1946 at natural gasoline and cycle plants, 2 percent more than in 1945. Principal gains over 1945 were in West Virginia, New Mexico, Oklahoma, and Kansas, in that order.

[1] Data for 1946 are preliminary.

[2] Tables (except those on sales of liquefied petroleum gases) compiled by E. M. Seeley, Petroleum Economics Division.

Salient statistics of the natural-gasoline industry in the United States, 1942–46, in thousands of gallons

	1942	1943	1944	1945	1946 [1]
Production:					
Natural gasoline and natural-gasoline mixtures	2,071,104	2,115,372	2,188,284	2,498,741	2,750,318
Liquefied petroleum gases:					
Isobutane	101,682	150,738	209,412	162,756	164,015
Other liquefied petroleum gases	671,874	760,116	961,212	1,250,468	1,236,862
Other products	654,864	657,846	843,024	792,208	685,217
Total	3,499,524	3,684,072	4,201,932	4,704,173	4,836,412
Receipts from outside sources	62,991	55,600	112,182	120,074	118,850
Stock change at plants and terminals	+29,316	−27,216	+798	+24,139	+33,996
Total supply	3,533,199	3,766,888	4,313,316	4,800,108	4,921,266
Shipments to refineries:					
Natural gasoline and natural-gasoline mixtures	1,755,357	1,938,136	2,060,985	2,384,216	2,525,431
Liquefied petroleum gases	428,501	463,955	534,274	657,018	372,249
Other products	501,725	466,143	629,949	496,895	345,344
Shipments to jobbers and trade outlets:					
Natural gasoline	274,794	162,890	118,608	94,155	130,675
Condensate				6,511	11,185
Finished gasoline and naphtha	141,006	129,262	134,610	229,948	260,052
Sales of liquefied petroleum gases:					
For fuel	302,190	486,738	608,881	668,698	856,505
For chemical manufacture	[2]	[2]	96,558	170,386	212,604
Transfers of cycle products	[3]	66,108	76,482	35,658	52,990
Exports from plants	43,778	23,612	28,351	31,453	120,171
Losses	85,848	30,044	24,618	25,170	34,060
Total demand at plants and terminals	3,533,199	3,766,888	4,313,316	4,800,108	4,921,266
Stocks at plants, terminals, and refineries:					
Natural gasoline	157,374	130,410	114,702	101,726	138,667
Liquefied petroleum gases	23,646	45,024	46,452	39,517	32,264
Other products	13,524	15,288	17,430 / [4] 25,788	40,270	38,278
Total	194,544	190,722	178,584 / [4] 186,942	181,513	209,209
Value at plants:					
Natural gasoline—thousands of dollars	78,170	95,273	[5] 110,800	112,018	113,600
Liquefied petroleum gases—do	19,000	24,410	[5] 34,300	41,994	36,100
Other products—do	24,395	27,227	[5] 37,400	33,552	29,300
Average per gallon—cents	3.5	4.0	[5] 4.3	4.0	3.7
Natural gas treated—millions of cubic feet	2,864,400	3,028,000	[5] 3,300,000	3,653,870	3,739,000
Average yield, light products except liquefied petroleum gases per M cubic feet—gallons	0.95	0.92	0.92	0.90	0.92
Average yield, all light products—do	1.22	1.22	1.27	1.29	1.29
Sales to consumers for fuel and chemical uses:					
L. P. G.	362,168	495,557	703,786	839,084	1,042,318
L. R. G.	223,272	179,676	356,370	437,682	662,964
Total	585,440	675,233	1,060,156	1,276,766	1,705,282
Total exports of natural gasoline and liquefied petroleum gases	57,414	35,154	42,702	62,971	177,959

[1] Subject to revision.
[2] Included in shipments to refineries.
[3] Not available.
[4] For comparison with 1945.
[5] Estimated.

Export shipments of 177,959 thousand gallons of light products in 1946 were almost three times the 1945 total. Canada and the United Kingdom received 47 and 38 percent, respectively, of the 1946 exports.

OUTLOOK

The vigorous increase in demand for light products in the late months of 1946 affected, with particular force, deliveries of liquefied petroleum gases for fuel uses and natural gasoline to refineries.

Production of the liquefied gases doubled during the war in response to continuing expansion of normal markets and unusually large requirements of petroleum refineries for production of aviation gasoline. A drop in refinery demand after the war checked temporarily the pronounced growth trend in total demand for these materials, but the resurgence in sales to record levels late in 1946 signalized a resumption under peacetime conditions of the rapid gains that characterized the prewar period.

Of the total output of liquid products by the natural-gasoline industry, liquefied petroleum gases comprised 21 percent in 1941 and 29 percent in 1946. Further gains in relative importance appear to be indicated for the future by the promising growth of old markets and such applications of recent moment as stand-by industrial uses, peak-load shaving in gas-utility operations, new uses in agriculture, and use as raw material for chemicals manufacture. Because demand is approaching the productive capacity of existing facilities, higher prices are being obtained by producers than for many years past. Relatively satisfactory prices are probable so long as the demand for fuels generally remains strong. Confidence in the future is stimulating construction of new facilities for production and transport, particularly of propane, of which a large potential supply is available at existing plants. The added cost to consumers incident to a higher wholesale price structure may be mitigated to some degree by greater efficiency of retail distribution, particularly where cost pressure from competing fuels is felt. Delivery direct to consumer-owned storage rather than by distributor-owned steel cylinders offers, according to trade reports, possibilities of significant savings in distribution costs.

The production of natural gasoline has grown less rapidly than the industry as a whole because of increasing fractionation operations at plants to separate—from the raw liquid condensates—the liquefied gases, finished gasoline, and other products and to recover more of the light ends contained in process gas. The proportion of natural gasoline recovered declined from 65 percent of total liquids in 1941 to 57 percent in 1946.

Of the total shipments of natural gasoline from plants, 95 percent were taken by refineries in 1945 and 92 percent in 1946. The reduction in this ratio was caused by sharply higher shipments for export and to jobbers. Growing markets and factors related to conservation of natural gas and petroleum have prompted initiation of many projects for construction of new facilities to produce natural gasoline and other light products. Material increments to supply appear therefore to be assured over the next 2 or 3 years. A current attempt to enlarge the refinery market for natural gasoline and butanes by increasing the proportion used in motor fuel will, if successful, add significantly to total demand.

The importance of petroleum refineries in the market for products as reported by the natural-gasoline industry has declined from 77 percent of the total in 1941 to 66 percent in 1946. Shipments to refineries expanded 19 percent in that period as deliveries of products to other markets increased over 100 percent. Further rapid growth in outside sales seems clearly indicated, particularly with respect to liquefied petroleum gases. Progressive diversification of markets is expected to strengthen the position of the industry generally in dealing

with its customers by permitting the competitive forces originating in several consuming groups to bear more effectively upon the market structure. Thus a slackening in demand in one market sector may more readily be compensated by increased sales in another, tending to produce greater stability in product prices.

RESERVES

The Committee on Natural Gas Reserves of the American Gas Association released on February 28, 1947, the first estimate of the reserves of natural-gas liquids in the United States. The term "natural-gas liquids" is used to describe "those hydrocarbon liquids that are gaseous in the reservoir but are obtainable by condensation or absorption." Natural gasoline, condensate, and liquefied petroleum gases fall in this category.

The reserves have been divided into the following classes, conforming to those used for the reserves of recoverable natural gas in which they are contained:

(1) Nonassociated—Liquids recoverable from free gas not in contact with crude oil in the reservoir.
(2) Associated—Liquids recoverable from free gas in contact with crude oil in the reservoir.
(3) Dissolved—Liquids recoverable from gas in solution in crude oil in the reservoir.

Estimated proved recoverable reserves of natural-gas liquids in the United States as of Dec. 31, 1946, in thousands of barrels

[Committee on Natural Gas Reserves, American Gas Association]

State	Reserves as of December 31, 1946				1946 Production
	Non-associated	Associated	Dissolved	Total	
Arkansas	41,071	8,306	12,223	61,600	3,457
California	40,328	107,300	160,644	308,272	21,885
Colorado	775	410	1,192	2,377	200
Illinois			[1] [2] 34,200	[2] 34,200	3,900
Indiana			[1] 85	85	16
Kansas	80,202	1,140	1,150	82,492	1,991
Kentucky	[1] 16,071			16,071	1,310
Louisiana	330,466	75,019	13,911	419,396	13,500
Michigan			[1] 655	655	309
Mississippi	17,212	34,095	192,594	243,901	108
Montana	8,534			8,534	108
New Mexico	27,697	30,950	14,962	73,609	2,818
Ohio	[1] 1,714			1,714	143
Oklahoma	45,597	10,020	12,700	68,317	9,875
Pennsylvania	[1] 2,309			2,309	262
Texas	1,292,177	296,072	397,357	1,985,606	66,134
West Virginia	[1] 19,285			19,285	2,400
Wyoming	458	9,400	15,600	25,458	846
Alabama, Florida, New York, and Utah			[1] 6	6	
Total	[3] 1,923,896	[3] 572,712	[2] [3] 857,279	[2] [3] 3,353,887	129,262

[1] Not allocable by types, but occurring principally in the column shown.
[2] Figure revised Mar. 11, 1947.
[3] Approximate total; see footnote 1.

Details of the committee's estimates of reserves of natural gas are shown in the Natural Gas chapter of this volume. On December 31, 1946, these reserves amounted to 160,575,901 million cubic feet. The comparable reserve of 3,353,887 thousand barrels of natural-gas liquids indicates an average content, extractable by methods now in use, of 0.87 gallon per thousand cubic feet of gas reserves. The average recoverable content of natural-gas liquids, in gallons per thousand cubic feet in each of the three types of natural-gas reserves—nonassociated, associated, and dissolved—are about 0.7, 0.9, and 2.0 respectively.

PRODUCTION

Production of all light products was at record levels in January–February 1946 but was below comparable 1945 rates during the spring and summer owing to the effects of inventory accumulations and a weak price structure. In the fourth quarter, production was stimulated by sharply higher demand and reached a new record of 14.2 million gallons daily in December, an increase of 8 percent over Decem-

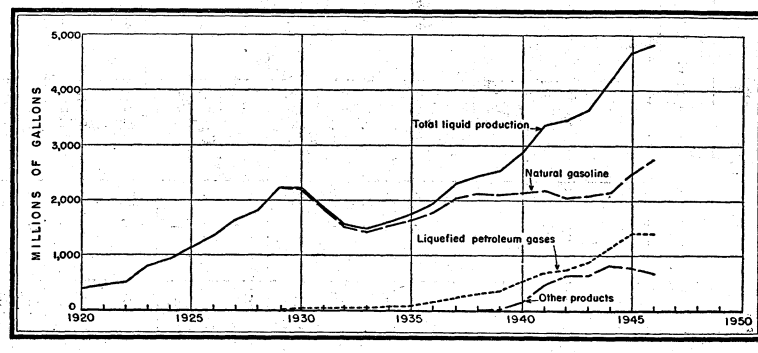

FIGURE 1.—Annual production of the natural-gasoline industry, 1920–46.

ber 1945. Total production in 1946 was 4,836,412 thousand gallons, a gain of 3 percent over 1945 that is attributable to larger output of natural gasoline.

Although the production of liquefied petroleum gases declined from 1,413,224 thousand gallons in 1945 to 1,400,877 thousand gallons in 1946, the rate of output accelerated rapidly in the fourth quarter to exceed the final quarter of 1945 by 21 percent. Declines in 1946 production of liquefied petroleum gases in Texas, Illinois, and Wyoming offset small increases in most other producing States.

Natural gasoline and allied products produced and natural gas treated in the United States, 1945–46, by States

State	Number of operators [2]	Production								Natural gas treated		
		Natural gasoline		Liquefied petroleum gases		Other products [1]		Total			Average yield (gallons per M cubic feet)	
		Thousands of gallons	Thousands of dollars	Thousands of gallons	Thousands of dollars	Thousands of gallons	Thousands of dollars	Thousands of gallons	Thousands of dollars	Millions of cubic feet	Light products except L. P. G.	All light products
1945												
Arkansas	9	51,215	2,472	32,109	833	2,617	113	85,941	3,418	55,725	0.97	1.54
California	30	655,151	27,034	160,331	5,259	76,271	2,439	891,753	34,732	420,482	1.74	2.12
Colorado		351	21					351	21			
Illinois	14	55,023	3,560	120,969	4,074			175,992	7,634	27,690	1.99	6.36
Kansas	8	58,309	2,687	14,328	379			72,637	3,066	165,538	.35	.44
Kentucky	4	9,267	498	37,484	817	128	7	46,879	1,322	41,562	.23	1.13
Louisiana	19	226,148	7,952	120,830	4,669	202,256	6,347	549,234	18,968	310,614	1.38	1.77
Michigan	2	5,310	295	8,320	227			13,630	522	4,271	1.24	3.19
Montana	1	2,876	187	1,850	110			4,726	297	12,000	.24	.39
New Mexico	7	86,040	4,794	11,757	257	3	[3]	97,800	5,051	116,539	.74	.84
New York	1	8	[3]					8	[3]	3	2.67	2.67
Ohio	5	5,733	327			719	42	6,452	369	35,210	.18	.18
Oklahoma	40	273,427	14,178	131,850	3,276	10,907	1,045	416,184	18,499	193,744	1.47	2.15
Pennsylvania	34	13,588	752	593	51			14,181	803	42,565	.32	.33
Texas	89	973,129	42,583	721,167	20,067	494,009	23,340	2,188,305	85,990	2,039,983	.72	1.07
Utah		867	52					867	52			
West Virginia	17	47,944	2,547	34,367	1,173	5,298	219	87,609	3,939	166,037	.32	.53
Wyoming	5	34,355	2,079	17,269	802			51,624	2,881	21,907	1.57	2.36
Total	234	2,498,741	112,018	1,413,224	41,994	792,208	33,552	4,704,173	187,564	3,653,870	.90	1.29
1946 [4]												
Arkansas	9	45,697	1,782	33,882	881	4,501	239	84,080	2,902	52,947	.95	1.59
California	30	644,561	28,361	178,390	4,995	87,518	3,413	910,469	36,769	405,942	1.80	2.24
Colorado		360	22					360	22			
Illinois	14	53,612	2,895	108,334	3,358			161,946	6,253	25,353	2.11	6.39
Kansas	9	66,289	2,525	19,007	475			85,296	3,000	180,867	.37	.47
Kentucky	4	9,227	489	45,064	991			54,291	1,480	49,400	.19	1.10
Louisiana	19	298,602	11,048	118,343	4,497	150,455	5,567	567,400	21,112	311,797	1.44	1.82
Michigan	2	4,690	216	7,534	210			12,224	426	3,512	1.34	3.48

Montana	1	2,634	183	1,981	109			4,615	292	10,956	.24	.42
New Mexico	7	87,693	3,771	15,393	339			103,086	4,110	138,517	.63	.74
New York	1	8	(3)					8	(3)	3	2.67	2.67
Ohio	5	5,275	237			1,069	48	6,344	285	35,066	.18	.18
Oklahoma	41	276,909	12,184	133,942	3,081	8,112	735	418,963	16,000	211,626	1.35	1.98
Pennsylvania	34	10,726	526	540	46			11,266	572	38,107	.28	.30
Texas	89	1,157,121	45,120	691,357	15,157	424,330	19,049	2,272,808	79,326	2,049,300	.77	1.11
Utah		856	51					856	51			
West Virginia	17	51,583	2,115	39,311	1,636	9,232	249	100,126	4,000	202,402	.30	.49
Wyoming	5	34,475	2,075	7,799	325			42,274	2,400	23,205	1.49	1.82
Total	236	2,750,318	113,600	1,400,877	36,100	685,217	29,300	4,836,412	179,000	3,739,000	.92	1.29

[1] Includes finished gasoline, condensate, kerosine, distillate fuel, "special" naphtha, etc.
[2] A producer operating in more than 1 State is counted but once in arriving at total for United States.
[3] Less than $500.
[4] Subject to revision.

793065—48——54

REVIEW BY STATES

California.—Light-product production of the industry in 1946 increased 2 percent over 1945 to 910,469 thousand gallons because of higher output in the 1946 fourth quarter. Production of liquefied petroleum gases increased 18 million gallons (11 percent) over 1945, as a decline of 11 million gallons in natural-gasoline production was balanced by an equal gain in "other products" originating at cycle plants. These group changes were opposite in direction to those east of California, emphasizing economic differences between the two regions.

Production at Kettleman Hills declined from 171 million gallons in 1945 to 160 million in 1946; Ventura Avenue declined similarly from 88 million gallons to 86 million gallons.

Louisiana.—Total production in 1946 of 567,400 thousand gallons compared with 549,234 thousand gallons in 1945. Small gains were reported in both the Gulf and inland districts. Natural-gasoline production increased 72.4 million gallons (32 percent) over 1945.

Oklahoma.—After a 4-year decline, production in 1946 increased to 419.0 million gallons from 416.2 million gallons in 1945. Output of the Oklahoma City field increased from 64 to 66 million gallons, but Osage County decreased from 73 to 69 million gallons. The Seminole district produced 126 million gallons of light products in 1946, 1 million gallons less than in 1945.

Monthly production of natural gasoline and allied products in the United States, 1945–46, by States and districts, in millions of gallons

Field	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1945													
West New York and West Pennsylvania	1.7	1.5	1.5	1.4	1.2	1.0	.8	.8	.8	1.1	1.2	1.2	14.2
West Virginia	8.6	7.7	7.6	7.0	7.1	5.8	5.4	5.3	4.9	8.5	9.4	10.3	87.6
Ohio	.8	.7	.6	.5	.5	.4	.4	.3	.5	.6	.6	.6	6.5
Illinois	15.8	14.1	15.4	15.2	15.3	15.0	15.2	15.1	12.7	13.7	14.4	14.1	176.0
Kentucky	3.1	3.6	4.4	4.4	4.5	4.0	3.6	3.6	1.2	4.8	4.6	5.1	46.9
Michigan	1.1	1.0	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.1	1.1	1.1	13.6
Kansas	6.0	5.9	5.6	5.5	5.9	6.0	5.9	5.9	6.1	5.9	7.1	6.8	72.6
Oklahoma	36.9	32.9	35.1	33.7	35.8	33.9	34.1	35.0	34.1	33.9	34.9	35.9	416.2
Texas:													
Gulf	56.8	50.8	54.7	52.0	54.2	52.5	56.4	55.3	50.9	52.8	52.2	55.1	643.7
East Texas	28.2	26.7	29.2	28.3	31.9	31.0	32.1	32.6	28.0	26.0	24.9	23.7	342.6
Panhandle	48.5	44.5	45.6	46.5	46.2	41.5	41.1	41.5	43.9	45.3	47.3	49.4	541.3
Rest of State	52.6	49.5	55.0	54.7	57.6	55.0	57.0	56.5	49.2	56.2	56.3	61.1	660.7
Total Texas	186.1	171.5	184.5	181.5	189.9	180.0	186.6	185.9	172.0	180.3	180.7	189.3	2,188.3
Arkansas	7.6	7.1	7.7	7.3	7.5	7.4	7.4	7.1	6.3	6.3	6.5	7.7	85.9
Louisiana:													
Gulf	29.9	26.2	28.4	24.5	27.2	26.9	27.5	27.8	20.7	24.3	27.0	27.5	317.9
Inland	20.7	18.9	21.4	20.7	21.4	21.3	21.5	18.0	6.6	18.3	19.9	22.6	231.3
Total Louisiana	50.6	45.1	49.8	45.2	48.6	48.2	49.0	45.8	27.3	42.6	46.9	50.1	549.2
New Mexico	6.3	6.0	8.5	8.5	8.9	9.2	9.2	9.3	8.7	8.1	7.9	7.2	97.8
Montana	.4	.4	.5	.4	.4	.3	.3	.3	.4	.3	.5	.5	4.7
Colorado, Utah, and Wyoming	4.7	4.7	5.0	4.5	5.4	4.7	4.9	4.4	3.8	3.8	3.5	3.5	52.9
California	76.2	68.0	75.2	75.2	78.0	75.2	78.3	77.8	72.4	70.7	71.1	73.7	891.8
Total United States	405.9	370.2	402.5	391.4	410.2	392.3	402.3	397.8	352.4	381.7	390.4	407.1	4,704.2
Daily average	13.1	13.2	13.0	13.0	13.2	13.1	13.0	12.8	11.7	12.3	13.0	13.1	12.9

Monthly production of natural gasoline and allied products in the United States, 1945–46, by States and districts, in millions of gallons—Continued

Field	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1946 [1]													
West New York and West Pennsylvania	1.3	1.2	1.1	.9	.9	.7	.6	.7	.7	.8	1.1	1.3	11.3
West Virginia	10.5	9.3	8.5	8.5	8.2	7.1	6.7	7.1	6.9	8.2	8.5	10.6	100.1
Ohio	.6	.5	.5	.5	.5	.4	.4	.4	.4	.6	.7	.8	6.3
Illinois	14.1	11.6	13.5	12.8	13.0	13.6	14.1	13.9	13.8	14.2	13.7	13.6	161.9
Kentucky	5.1	5.1	3.9	3.8	4.2	4.0	4.0	4.4	4.5	4.9	4.9	5.5	54.3
Michigan	1.1	1.0	1.1	1.2	1.1	1.2	1.2	1.1	1.0	1.1	.8	.3	12.2
Kansas	6.7	6.7	6.2	6.5	6.7	6.6	6.4	7.0	7.4	7.9	8.5	8.7	85.3
Oklahoma	36.9	34.5	35.5	32.3	33.8	32.8	33.5	34.1	34.1	37.1	36.4	38.0	419.0
Texas:													
Gulf	48.5	41.3	43.3	41.3	44.7	43.0	44.9	45.6	44.1	47.7	48.0	48.5	540.9
East Texas	27.1	24.5	27.9	31.7	32.8	27.1	31.0	31.7	31.2	31.0	29.3	31.4	356.7
Panhandle	46.3	43.1	44.5	38.0	33.9	47.8	35.2	42.3	44.5	48.0	47.6	48.3	519.5
Rest of State	67.1	62.7	67.4	65.6	71.0	70.7	73.8	77.3	74.8	75.7	72.5	77.1	855.7
Total Texas	189.0	171.6	183.1	176.6	182.4	188.6	184.9	196.9	194.6	202.4	197.4	205.3	2,272.8
Arkansas	7.2	6.5	6.6	6.5	6.8	6.7	6.7	7.0	7.0	7.7	7.6	7.8	84.1
Louisiana:													
Gulf	29.4	26.8	25.0	28.3	27.6	24.7	28.4	26.4	27.8	28.3	27.6	30.2	330.5
Inland	22.7	21.1	18.8	18.6	19.9	19.0	18.8	20.1	15.7	20.0	20.7	21.5	236.9
Total Louisiana	52.1	47.9	43.8	46.9	47.5	43.7	47.2	46.5	43.5	48.3	48.3	51.7	567.4
New Mexico	7.5	7.3	8.0	8.2	8.5	9.1	9.6	9.4	9.0	8.9	8.7	8.9	103.1
Montana	.5	.5	.5	.3	.3	.3	.3	.3	.3	.4	.4	.5	4.6
Colorado, Utah, and Wyoming	3.6	3.2	3.3	3.3	3.2	3.5	3.5	3.6	3.7	4.3	4.1	4.2	43.5
California	78.8	71.5	76.0	72.8	76.8	74.4	76.1	73.8	68.9	78.5	79.1	83.8	910.5
Total United States	415.0	378.4	391.6	381.1	393.9	392.7	395.2	406.2	395.8	425.3	420.2	441.0	4,836.4
Daily average	13.4	13.5	12.6	12.7	12.7	13.1	12.7	13.1	13.2	13.7	14.0	14.2	13.3

[1] Subject to revision.

Texas.—Continued expansion of operations raised total light-products output from 2,188 million gallons in 1945 to 2,273 million gallons in 1946, amounting to 47 percent of the United States total. Natural-gasoline production increased 19 percent over 1945, in contrast to declines of 4 and 14 percent in liquefied petroleum gases and other products, respectively.

Through the first 5 months of 1946 the production rate approximated that of the comparable 1945 period but trended upward through the balance of 1946 to record levels, as demand for light products expanded.

Other States.—Total production reached record levels in Kentucky and New Mexico, gaining 16 and 5 percent, respectively, over 1945. Materially higher output in 1946 in West Virginia and Kansas approached the largest totals of recent years in these States. Principal 1946 declines were in Illinois and Wyoming.

YIELDS, PROCESSES, AND NUMBER OF PLANTS

Cycle Plants.—Approximately 1,327 million gallons of liquid products were recovered at cycle plants in 1946 from 887 billion cubic feet of processed natural gas, an indicated yield of 1.50 gallons per thousand cubic feet. At individual plants, yields varied from less than 0.5 gallon to about 5 gallons per thousand cubic feet of gas treated. Currently, 20 percent or more of cycle-plant production consists of finished gasoline and naphtha.

Yields.—The average yield of all light products was 1.29 gallons per thousand cubic feet of natural gas processed (final figures) in 1945 and was unchanged in 1946 (preliminary figures). However, the yield of liquefied petroleum gases declined from 0.39 to 0.37 gallon owing to lower demand in 1946 for some of these materials. The yield of butanes at plants with suitable fractionating equipment is relatively high, in many instances approaching 100 percent of the available product. Propane yields range much lower, perhaps from 10 to 30 or 40 percent of the total available in process gas at specific plants, because market requirements in the past have not provided enough incentive for making the additional investment in equipment required for more complete recovery.

The average yield of natural gasoline increased from 0.68 gallon per thousand cubic feet in 1945 to 0.74 gallon in 1946, responding to higher demand from refineries, jobbers, and for export.

Production by Processes.—The reduction in the number of operating plants—from 610 in 1944 to 606 in 1945—was smaller than has been usual for many years. In the period 1935–45 the number of compression-type plants has decreased from 312 to 181, the absorption-type from 393 to 384, and charcoal-process from 10 to 3. The 38 cycle plants reported in 1945 represent a net gain since 1935, as none were in existence at that time.

Natural gasoline and allied products produced in the United States in 1945, by States and by methods of manufacture [1]

State	Number of plants operating				Production (thousands of gallons)			
	Compression [2]	Absorption [3]	Cycling [4]	Total	Compression [2]	Absorption [3]	Cycling [4]	Total
Arkansas		12		12		85,941		85,941
California	2	77	2	81	6,207	779,544	106,002	891,753
Colorado						[5] 351		351
Illinois	16	7		23	546	175,446		175,992
Kansas	2	12		14	1,202	71,435		72,637
Kentucky	2	3		5	892	45,987		46,879
Louisiana	4	26	5	35	10,683	139,288	399,263	549,234
Michigan		2		2		13,630		13,630
Montana		1		1		4,726		4,726
New Mexico	2	7		9	2,718	95,082		97,800
New York	1			1	8			8
Ohio	2	7		9	1	6,451		6,452
Oklahoma	18	81		99	19,573	396,611		416,184
Pennsylvania	47	10		57	1,090	13,091		14,181
Texas	31	116	31	178	181,356	1,262,487	744,462	2,188,305
Utah						[5] 867		867
West Virginia	52	22		74	20,924	66,685		87,609
Wyoming	2	4		6	957	50,667		51,624
Total: 1945	181	387	38	606	246,157	3,208,289	1,249,727	4,704,173
1944	190	385	35	610	213,612	2,966,292	1,022,028	4,201,932

[1] Figures for 1946 not yet available.
[2] Includes 17 plants manufacturing liquefied petroleum gases.
[3] Includes combination of absorption process with compression and charcoal processes. Includes 188 plants manufacturing liquefied petroleum gases; and 3 charcoal plants in West Virginia with 1,461,000 gallons produced in 1945 and 3 charcoal plants with 3,770,000 gallons in 1944.
[4] Includes 26 plants manufacturing liquefied petroleum gases.
[5] Drip gasoline.

In 1935, States east of the Mississippi River had 38 percent of all plants in the United States, with only 4 percent of the total production of light products. In 1945, the number of plants in this area had declined to 28 percent, but their output amounted to 7 percent of the United States total. Thus, the increase in output of the Eastern States has been proportionately greater than in the West because of large gains in Illinois, Kentucky, and West Virginia.

From January 1, 1940, to January 1, 1946, the capacity of all plants increased 54 percent to 17,928,000 gallons of liquid products per day (6, 544 million gallons per year). During 1946 several large new plants began operations, among which three in the great Carthage gas and condensate field of eastern Texas added about 400,000 gallons daily of new capacity.

Technologic Trends.—The number of plants producing liquefied petroleum gases increased from 202 in 1944 to 231 in 1945. Responding to rapid growth in demand, the output of these products, amounting to 21 percent of the total for the natural-gasoline industry in 1941, expanded to 29 percent in 1946, the first full peacetime year.

The probable future enlargement in demand for liquefied petroleum gases, for established and new uses, suggests that production facilities of the natural-gasoline industry and those of petroleum refineries as well may be utilized at near-capacity rates for an extended period. The plants now planned for construction at Brownsville, Tex., and in southwestern Kansas, to produce liquid hydrocarbons from dry natural gas by synthetic chemical means, may also become a minor source of liquefied petroleum gases, according to trade reports.

Research is being conducted by the industry to determine the practicability of using relatively more natural gasoline and butanes in motor fuel. A favorable conclusion of this enterprise would broaden significantly the market for these materials.

MARKET DEMAND—SHIPMENTS

The demand for light products of natural gasoline and cycle plants continued in 1946 the upward trend that has persisted since 1934, reaching a total of 4,921,266 thousand gallons, 3 percent above 1945. Deliveries of natural gasoline were 9 percent higher than in 1945; but the liquefied petroleum gases and other products groups were 0.4 and 13 percent lower, respectively.

Shipments to Refineries.—The relative importance of shipments to refineries decreased from 74 percent of total demand on the industry in 1945 to 66 percent in 1946 as volume declined from 3,538,129 thousand gallons to 3,243,024 thousand gallons. The principal decline was in refinery takings of liquefied petroleum gases, which were 284,769 thousand gallons (43 percent) below 1945. The demand for isobutane only was well-maintained at levels above those in the late months of 1945. Shipments of condensate contracted 18 percent and of finished gasoline and naphtha 85 percent to negligible proportions late in 1946. The only gain was reported in the major product, natural gasoline, shipments of which reached the record total of 2,525,431 thousand gallons, 6 percent more than in 1945.

Supply and distribution at plants of natural gasoline and allied products in the United States, 1945–46, by months, in thousands of gallons

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1945													
Production:													
Natural gasoline and natural-gasoline mixtures	200,049	182,181	202,379	200,785	214,561	209,914	216,491	219,317	208,001	206,160	219,591	219,312	2,498,741
Raw condensate	43,637	36,646	39,642	36,747	37,685	35,199	35,430	33,551	24,131	34,294	31,196	33,394	421,552
Liquefied petroleum gases:													
Commercial butane-propane mixture	30,880	25,193	24,069	21,725	21,601	19,325	18,544	19,510	20,011	26,131	29,623	39,583	296,195
Normal butane	39,707	38,421	41,894	38,358	36,231	32,534	33,805	31,167	27,952	32,124	26,827	29,543	408,563
Propane	21,645	22,236	22,782	23,725	24,796	21,510	21,915	22,986	23,055	24,471	24,110	24,165	277,396
Other mixture (L. P. G.)	11,256	11,365	12,788	13,442	17,001	15,703	15,829	15,261	8,244	11,534	10,555	12,021	154,999
Isobutane	15,789	13,152	14,703	13,592	14,296	13,808	14,037	13,771	11,265	11,590	13,580	13,173	162,756
Isopentane	13,220	12,037	12,894	12,847	13,058	12,034	13,067	11,968	4,472	2,431	3,726	1,561	113,315
Finished gasoline and naphtha	26,707	25,773	27,943	27,086	27,903	29,079	30,217	27,808	23,368	30,608	27,949	30,516	334,957
Other products	3,014	3,158	3,432	3,076	3,124	3,231	2,943	2,470	1,879	2,361	3,219	3,792	35,699
Total	405,904	370,162	402,526	391,383	410,256	392,337	402,278	397,809	352,378	381,704	390,376	407,060	4,704,173
Receipts from outside sources	11,358	14,699	10,935	9,789	8,450	8,282	8,562	8,050	9,066	9,778	11,360	9,745	120,074
Stock change at plants and terminals	−2,927	+10,850	+536	+6,826	+3,348	−6,773	−6,530	−1,112	+9,338	−2,046	+8,890	+3,739	+24,139
Total supply	420,189	374,011	412,925	394,346	415,358	407,392	417,370	406,971	352,106	393,528	392,846	413,066	4,800,108
Shipments to refineries:													
Natural gasoline and natural-gasoline mixtures	191,512	170,487	193,994	183,792	201,870	203,588	210,506	212,548	196,662	203,120	205,478	210,659	2,384,216
Condensate	42,512	35,768	37,756	36,084	36,645	33,985	34,313	32,577	23,020	32,401	29,883	31,069	406,013
Normal butane	20,277	21,207	23,370	21,753	19,387	18,329	19,998	14,985	9,745	15,103	7,868	5,962	197,984
Isobutane	13,546	13,072	15,162	13,501	13,501	13,655	14,216	13,977	9,873	9,871	13,023	11,297	154,694
Isopentane	12,815	11,638	12,219	13,259	14,094	12,437	12,970	10,175	6,436	2,498	2,733	2,432	113,706
Other L. P. G.	19,080	14,894	16,342	15,218	19,609	18,025	18,755	18,176	13,105	14,037	13,135	10,258	190,634
Finished gasoline and naphtha	10,009	8,548	9,141	8,934	8,613	8,107	6,756	6,362	3,645	6,979	6,735	7,053	90,882
Shipments to jobbers and trade outlets:													
Natural gasoline	9,437	9,718	9,174	8,965	8,491	7,977	9,065	7,209	5,624	6,971	6,131	5,393	94,155
Condensate	907	864	1,032	458	540	417	367	372	380	423	334	417	6,511
Finished gasoline and naphtha	16,377	15,438	19,999	18,436	18,120	22,234	22,171	19,608	17,218	19,387	19,987	20,973	229,948
Liquefied petroleum gases:													
For fuel	64,819	56,243	54,006	51,255	53,961	47,512	47,007	46,783	48,139	59,693	63,239	76,041	668,698
For chemical manufacture	11,286	11,155	13,634	14,709	15,385	15,192	13,629	15,104	12,444	14,222	16,381	17,245	170,386
Transfers of cycle products	3,020	3,060	3,613	3,468	3,063	3,200	3,228	2,341	1,695	2,136	3,176	3,658	35,658
Exports and losses	4,592	1,919	3,483	4,514	2,079	2,734	4,389	6,754	4,120	6,687	4,743	10,609	56,623
Total demand at plants and terminals	420,189	374,011	412,925	394,346	415,358	407,392	417,370	406,971	352,106	393,528	392,846	413,066	4,800,108

1946[1]													
Production:													
Natural gasoline and natural-gasoline mixtures	226,615	209,318	224,303	226,219	231,826	237,086	236,221	237,757	229,176	236,471	225,916	229,410	2,750,318
Raw condensate	37,899	34,015	30,571	30,327	30,648	26,184	27,176	24,663	22,558	28,453	27,674	30,297	350,465
Liquefied petroleum gases:													
Commercial butane-propane mixture	41,419	36,398	35,273	30,162	29,933	26,841	27,409	31,030	30,933	40,444	42,801	47,878	420,521
Normal butane	27,379	28,267	29,667	25,600	22,604	28,835	25,677	28,619	30,942	29,558	31,834	30,550	339,532
Propane	25,990	22,305	22,625	22,007	24,024	23,266	26,642	27,857	29,071	32,230	34,835	36,311	327,163
Other mixtures (L. P. G.)	12,362	11,307	9,817	9,125	9,166	8,082	6,905	8,727	7,162	9,180	9,808	11,770	113,411
Isobutane	13,793	12,133	11,626	12,573	16,082	13,615	14,291	13,553	12,687	14,106	13,503	16,053	164,015
Isopentane	3,271	2,266	3,319	2,998	4,546	2,519	2,552	4,507	2,733	3,028	1,929	2,567	36,235
Finished gasoline and naphtha	22,441	18,595	20,322	18,205	20,721	21,847	23,277	24,431	25,857	26,889	26,568	30,208	279,361
Other products	3,887	3,830	4,061	3,843	4,385	4,440	5,007	5,026	4,689	4,905	5,337	5,981	55,391
Total	415,056	378,434	391,584	381,059	393,935	392,715	395,157	406,170	395,808	425,264	420,205	441,025	4,836,412
Receipts from outside sources	10,969	7,417	9,370	9,654	10,674	9,445	11,553	11,541	10,871	8,470	10,813	8,073	118,850
Stock change at plants and terminals	+21,386	+26,709	+30,938	+4,542	−139	+15,968	+1,688	−10,009	+2,324	−17,853	−21,751	−19,807	+33,996
Total supply	404,639	359,142	370,016	386,171	404,748	386,192	405,022	427,720	404,355	451,587	452,769	468,905	4,921,266
Shipments to refineries:													
Natural gasoline and natural-gasoline mixtures	204,165	181,459	196,090	197,661	207,723	200,325	207,906	218,472	224,248	231,512	228,441	227,429	2,525,431
Condensate	35,847	29,543	27,837	29,095	28,659	25,735	25,656	24,224	21,672	27,562	25,875	29,831	331,536
Normal butane	8,391	8,961	10,727	9,896	8,658	7,321	7,208	5,311	6,152	6,217	6,161	6,147	91,150
Isobutane	11,530	10,428	9,296	11,261	14,070	12,297	12,649	9,799	10,734	10,489	9,916	13,862	136,331
Isopentane	2,837	2,421	2,322	3,675	3,354	2,847	2,921	4,704	2,445	2,873	2,462	3,108	35,969
Other L. P. G.	11,910	10,985	11,775	11,381	12,500	10,089	10,952	10,635	3,162	3,882	5,784	5,744	108,799
Finished gasoline and naphtha	1,613	1,066	1,499	2,015	1,678	1,223	664	912	664	805	819	850	13,808
Shipments to jobbers and trade outlets:													
Natural gasoline	6,382	5,414	4,759	10,098	7,008	15,299	15,651	12,030	13,856	13,761	14,151	12,266	130,675
Condensate	1,363	2,231	1,484	1,243	1,120	480	612	385	725	703	483	356	11,185
Finished gasoline and naphtha	21,315	17,083	15,571	18,861	17,776	18,121	22,779	27,666	18,424	26,300	26,849	29,307	260,052
Liquefied petroleum gases:													
For fuel	75,920	66,352	61,636	57,878	59,414	55,084	63,777	70,805	69,846	83,676	90,736	101,381	856,505
For chemical manufacture	17,197	16,507	16,560	16,271	19,222	18,517	17,196	16,784	17,581	18,984	18,612	19,173	212,604
Transfers of cycle products	3,344	3,728	3,930	3,647	3,331	4,558	4,466	4,537	5,115	5,601	4,842	5,891	52,990
Exports and losses	2,825	2,964	6,530	13,189	20,235	14,296	12,585	21,456	9,731	19,222	17,638	13,560	154,231
Total demand at plants and terminals	404,639	359,142	370,016	386,171	404,748	386,192	405,022	427,720	404,355	451,587	452,769	468,905	4,921,266

[1] Subject to revision.

Natural gasoline and allied products utilized at refineries in the United States, 1945–46, by districts and months, in thousands of gallons

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
1945													
East Coast	10,962	9,828	10,668	5,712	5,838	8,610	9,702	4,074	840	1,302	2,016	1,302	70,854
Appalachian	1,596	1,470	1,344	1,344	1,176	1,260	1,050	1,218	1,428	2,016	2,184	2,184	18,270
Indiana, Illinois, Kentucky, etc	33,726	33,348	30,114	32,466	30,744	27,594	28,728	30,702	26,838	21,966	28,014	24,738	348,978
Oklahoma, Kansas, and Missouri	19,362	12,558	18,648	14,868	16,926	20,034	19,404	16,758	14,616	21,294	25,074	23,478	223,020
Texas:													
Gulf Coast	80,514	66,906	80,010	74,550	72,198	73,038	76,146	74,802	49,560	68,502	72,870	64,932	854,028
Inland	28,476	29,736	37,758	34,398	37,002	35,322	38,220	36,750	38,724	43,134	29,904	32,382	421,806
Total Texas	108,990	96,642	117,768	108,948	109,200	108,360	114,366	111,552	88,284	111,636	102,774	97,314	1,275,834
Louisiana-Arkansas:													
Louisiana Gulf Coast	16,086	12,894	9,870	10,332	11,844	13,524	18,396	16,212	7,560	7,686	7,854	7,392	139,650
Arkansas and Louisiana Inland	6,804	6,384	7,056	10,080	8,946	8,862	9,492	9,198	5,376	6,636	7,728	7,434	93,996
Total Louisiana-Arkansas	22,890	19,278	16,926	20,412	20,790	22,386	27,888	25,410	12,936	14,322	15,582	14,826	233,646
Rocky Mountain	3,948	3,360	6,258	5,292	5,964	6,636	6,216	6,678	6,342	4,452	3,906	4,032	63,084
California	66,486	52,710	56,070	66,192	66,150	59,850	67,788	65,520	62,118	53,298	48,300	55,440	719,922
Total United States	267,960	229,194	257,796	255,234	256,788	254,730	275,142	261,912	213,402	230,286	227,850	223,314	2,953,608
1946 [1]													
East Coast	3,234	3,612	2,730	2,016	4,158	3,108	1,596	5,838	3,780	6,384	7,434	5,712	49,602
Appalachian	2,394	1,848	1,470	1,260	1,302	1,386	1,176	1,806	2,352	2,184	1,890	2,142	21,210
Indiana, Illinois, Kentucky, etc	20,706	20,202	19,110	20,622	22,008	25,200	28,644	29,484	28,476	27,762	29,148	25,998	297,360
Oklahoma, Kansas, and Missouri	21,672	15,078	16,254	14,406	14,532	15,120	17,094	19,740	22,008	27,636	26,040	25,368	234,948
Texas:													
Gulf Coast	67,788	42,672	47,334	47,796	47,040	48,888	50,736	60,270	56,406	63,126	66,654	58,254	656,964
Inland	24,654	35,322	37,380	37,422	42,252	39,186	38,598	42,546	37,968	36,582	43,890	45,276	461,076
Total Texas	92,442	77,994	84,714	85,218	89,292	88,074	89,334	102,816	94,374	99,708	110,544	103,530	1,118,040
Louisiana-Arkansas:													
Louisiana Gulf Coast	8,820	5,670	5,082	8,232	8,526	9,114	8,316	9,198	10,458	9,156	10,920	12,894	106,386
Arkansas and Louisiana Inland	7,182	6,342	4,956	3,360	3,780	4,032	3,822	4,200	4,998	5,418	4,830	4,662	57,582
Total Louisiana-Arkansas	16,002	12,012	10,038	11,592	12,306	13,146	12,138	13,398	15,456	14,574	15,750	17,556	163,968
Rocky Mountain	4,200	3,360	3,528	2,982	2,856	2,562	2,898	3,528	3,444	4,746	4,452	4,410	42,966
California	50,904	52,710	56,154	50,358	58,044	58,884	66,738	65,898	56,490	69,972	66,486	59,430	712,068
Total United States	211,554	186,816	193,998	188,454	204,498	207,480	219,618	242,508	226,380	252,966	261,744	244,146	2,640,162

[1] Subject to revision.

The percentage of natural gasoline and allied products in refinery gasoline declined from 9.1 in 1945 to 8.4 in 1946, primarily because of the curtailed use of liquefied petroleum gases in refining operations in 1946.

"Direct" Sales.—Jobbers and other trade outlets purchased 401,912 thousand gallons of products of the natural-gasoline industry in 1946, an increase of 22 percent over 1945. Such sales trended upward during the year, reaching 41,929 thousand gallons in December, compared with 26,783 thousand gallons in December 1945. Finished gasoline and naphtha comprised 65 percent of 1946 sales, natural gasoline 32 percent, and condensate 3 percent.

Sales of liquefied petroleum gases for fuel were 28 percent greater than in 1945, amounting to 856,505 thousand gallons. Fourth-quarter sales, reflecting strong seasonal and growth factors, exceeded the comparable 1945 period by 39 percent. Sales of liquefied petroleum gases for chemical manufacture, including synthetic rubber, increased 25 percent over 1945 to 212,604 thousand gallons. The chemical industry utilizes also a large volume of liquefied gases from petroleum refining.

Percentage of natural gasoline and allied products in refinery gasoline in the United States, 1942–46, by districts

Year	East Coast	Appalachian	Indiana, Illinois, Kentucky	Oklahoma, Kansas, Missouri	Texas Inland	Texas Gulf Coast	Louisiana Gulf Coast	Arkansas and Louisiana Inland	Rocky Mountain	California	Total
1942	1.4	2.1	5.8	6.3	16.0	13.9	13.1	11.6	4.8	16.7	9.6
1943	1.1	1.9	6.0	8.6	21.2	14.2	18.3	12.9	4.0	15.0	10.3
1944	2.3	1.7	6.3	7.1	17.8	11.6	12.6	16.5	5.7	13.6	9.3
1945	1.7	1.7	5.8	7.3	20.5	10.9	7.5	19.3	6.9	14.2	9.1
1946[1]	1.2	1.9	5.0	7.9	22.7	8.8	5.1	16.6	4.7	15.4	8.4

[1] Subject to revision.

SALES OF LIQUEFIED PETROLEUM GASES

Domestic deliveries of liquefied petroleum gases sold for fuel, chemical raw material, and synthetic rubber components increased from 1,276,766,000 gallons in 1945 to 1,705,282,000 in 1946—a gain of 34 percent compared with an expansion of 20 percent in 1945 over 1944 It is believed that the volume of domestic sales in 1946 would have been even greater had more pressure-tank cars and trucks been available for distribution purposes and had additional equipment for the use of these liquid gases been more readily obtainable. Exports of liquefied petroleum gases increased from 26,059,000 gallons in 1945 to 49,091,000 in 1946—a gain of 88 percent, according to the Bureau of the Census, United States Department of Commerce. The outstanding growth of this trade in 1946 compares with an increment of 79 percent in 1945 over 1944.

The totals for the different uses of liquefied petroleum gases rose sharply in 1946, except that for internal-combustion-engine fuel, which showed only a small gain, and the quantity for industrial fuel, which dropped slightly. Sales of liquefied petroleum gases for domestic or household fuel have more than doubled since 1943; the 1946 total of 766,150,000 gallons was 44 percent over the 1945 demand of 533,262,-

000, and this expansion compares with gains of 20 percent in 1945 and 29 percent in 1944. Deliveries of liquefied petroleum gases for domestic fuel made up 45 percent of the total for all uses in 1946, a slightly larger proportion than the 42 percent reported for both 1944 and 1945. The purchases of liquefied petroleum gases by manufactured-gas companies have mounted steadily in recent years and the volume reported for 1946—86,660,000 gallons—was 61 percent over the 1945 quantity of 53,849,000 and nearly double the 1944 total. Sales of liquefied petroleum gases credited to manufactured-gas companies represented 5 percent of all deliveries in 1946 in contrast to 4 percent of the total for both 1944 and 1945.

Sales of liquefied petroleum gases in the United States, 1942–46, by uses, methods of transportation, and regional distribution, in thousands of gallons

	Butane	Propane	Butane-propane mixtures	Total	
				Quantity	Percent of total
1942	128,560	150,511	301,917	[1] 585,440	100.0
1943	140,122	218,273	312,683	[1] 675,233	100.0
1944 [2]	122,870	324,355	450,846	898,071	100.0
1944 [3]	273,116	335,884	451,156	1,060,156	100.0
1945					
By uses:					
Domestic	52,866	216,415	263,981	533,262	41.8
Gas manufacturing	15,637	22,323	15,889	53,849	4.2
Industrial fuel	42,043	105,040	16,038	163,121	12.8
Synthetic rubber components	181,857	26,526	404	208,787	16.3
Chemical manufacturing	26,227	66,776	131,288	224,291	17.6
Internal-combustion-engine fuel	6,469	7,453	79,418	93,340	7.3
All other uses	41	48	27	116	
	325,140	444,581	507,045	1,276,766	100.0
Percent of total	25.5	34.8	39.7	100.0	
Regional distribution:					
Pacific Coast area	17,396	53,330	116,485	187,211	14.7
All other areas	307,744	391,251	390,560	1,089,555	85.3
Total 1945	325,140	444,581	507.045	1,276,766	100.0
1946 [4]					
By uses:					
Domestic	45,285	312,240	408,625	766,150	44.9
Gas manufacturing	25,682	41,199	19,779	86,660	5.1
Industrial fuel	48,100	91,033	19,982	159,115	9.3
Synthetic rubber components	268,946	19,631	865	289,442	17.0
Chemical manufacturing	45,959	76,412	185,284	307,655	18.1
Internal-combustion-engine fuel	4,467	8,297	83,458	96,222	5.6
All other uses		15	23	38	
	438,439	548,827	718,016	1,705,282	100.0
Percent of total	25.7	32.2	42.1	100.0	
Regional distribution:					
Pacific Coast area	31,286	73,395	136,435	241,116	14.1
All other areas	407,153	475,432	581,581	1,464,166	85.9
Total 1946	438,439	548,827	718,016	1,705,282	100.0

[1] Includes pentane as follows, in thousands of gallons: 1942, 4,452; 1943, 4,155. Corresponding figures for later years not available.
[2] Excludes synthetic rubber components (for comparison with earlier years).
[3] Includes material delivered for synthetic rubber components.
[4] Subject to revision.

Over a third of all sales of liquefied petroleum gases were sold for nonfuel uses in 1946. The quantity reported for synthetic rubber components increased from 208,787,000 gallons in 1945 to 289,442,000

in 1946, a 39-percent gain, while in addition the total indicated for chemical raw material of 307,655,000 gallons was 37 percent above the 1945 demand of 224,291,000 gallons and more than double 1944 requirements. It is believed that the demand for liquefied petroleum gases for use in the manufacture of synthetic rubber probably reached a "peak" volume in 1946, as the output of synthetic rubber is being curtailed as more natural rubber becomes available. It should be added, however, that the greater shrinkage in the demand for raw material going into synthetic rubber has been in the alcohols from agriculture sources because of their higher cost rather than in liquefied gases derived from petroleum and natural gas. The liquefied petroleum gases reported for chemical raw material in 1946 are believed to be below the actual demand by chemical plants as some of the other hydrocarbons such as ethane, pentane, hexane, and heptane are not included, and furthermore, it is also believed that some companies did not report all material moved to chemical plants by pipe lines.

The volume of sales of liquefied petroleum gases for internal-combustion-engine fuel has expanded very little in recent years, due both to wartime regulations and equipment shortages, and the 1946 quantity of 96,222,000 gallons is only 3 percent above the 1945 total of 93,340,000 gallons. Furthermore, the liquefied petroleum gases sold for motor fuel have declined from a 9-percent proportion of total deliveries for all uses in 1944 to a 7-percent share in 1945 and a 6-percent share in 1946. The use of liquefied petroleum gases for industrial fuel declined from 163,121,000 gallons in 1945 to 159,115,000 in 1946—a 3-percent shrinkage compared with a slight gain in 1945 over 1944. This lack of growth in the use of liquefied petroleum gases as an industrial fuel in recent years was largely the result of shortages of equipment for its handling and use. Diversion of supplies for competitive uses, especially for chemical raw material, was probably also a factor.

The proportion of butane in the total sales of liquefied petroleum gases has remained just below 26 percent in recent years, while some slight variations are noted in the shares for propane and butane-propane mixtures. The percentage for propane rose from 32 percent of total deliveries in 1944 to about 35 percent in 1945, but again dropped to slightly over 32 percent of the total in 1946. Butane-propane mixtures as reported declined from nearly 43 percent of total sales of liquefied petroleum gases in 1944 to 40 percent in 1945 and then turned upward to a 42-percent share of all deliveries in 1946.

Butane sold as liquefied petroleum gas increased from 325,140,000 gallons in 1945 to 438,439,000 in 1946—a gain of 35 percent compared with a 19-percent expansion in 1945 over 1944. All uses of butane showed gains in 1946 except quantities delivered for domestic and internal-combustion-engine fuels. Over 60 percent of the total butane was reported as sold for synthetic rubber components in 1946, and the quantity—268,946,000 gallons was 48 percent over the 1945 demand of 181,857,000 gallons. The use of butane in chemical manufacturing rose by 75 percent from 26,227,000 gallons in 1945 to 45,959,000 in 1946; however, the volume of this demand is not relatively important at the present time.

Butane delivered for domestic or household fuel has fluctuated from 27,565,000 gallons in 1944 to 52,866,000 in 1945 and then down by 14

percent to 45,285,000 gallons in 1946. The increasing pressure for butane as raw material used in the manufacture of motor fuel, synthetic rubber, and chemical products apparently has forced distributors to turn more to propane and butane-propane mixtures to satisfy the domestic fuel demand. The use of butane as industrial fuel rose from 42,043,000 gallons in 1945 to 48,100,000 in 1946—a 14-percent gain; however, the total is still below quantities reported during the war years.

Sales of butane to manufactured-gas companies increased noticeably from 15,637,000 gallons in 1945 to 25,682,000 in 1946—a 64-percent gain. The expansion in this demand in 1946 compares with a 5-percent increment in 1945 and a shrinkage by a third in 1944. A small quantity of butane is reported as fuel for internal-combustion engines, and the total has declined sharply from a peak demand of 18,799,000 gallons in 1941 to 4,467,000 in 1946, due to wartime restrictions, lack of equipment, and competitive demands for this liquid gas.

Reported deliveries of propane in 1946—548,827,000 gallons—were 23 percent over the 1945 demand of 444,581,000 gallons. Most of the propane is sold for domestic or household fuel, and this demand increased by 44 percent from 216,415,000 gallons in 1945 to 312,240,000 in 1946. A fairly important quantity of propane is also used as industrial fuel; however, the total declined from 105,040,000 gallons in 1945 to 91,033,000 in 1946, as this class of consumers used more butane and butane-propane mixtures to satisfy their requirements.

Manufactured-gas companies are using rapidly increasing quantities of liquefied petroleum gases in their operations, and nearly half of their requirements are for propane, the total of which nearly doubled from 22,323,000 gallons in 1945 to 41,199,000 in 1946. Very little propane is used as fuel in internal-combustion engines; however, the quantity is gradually increasing and the 1946 total of 8,297,000 gallons was 11 percent over the 1945 item of 7,453,000 gallons.

The nonfuel uses of propane are not relatively important up to the present time; however, quantities consumed as chemical raw material have jumped from less than 5,000,000 gallons in 1943 to 66,776,000 in 1945 and 76,412,000 in 1946, while propane going to synthetic rubber plants has fluctuated from 11,529,000 gallons in 1944 to 26,526,000 in 1945 and then down to 19,631,000 gallons in 1946.

Butane-propane mixtures reported to the Bureau of Mines increased from 507,045,000 gallons in 1945 to 718,016,000 in 1946—a 42-percent gain and a greater expansion in volume than that shown for either butane or propane. Most of these "mixtures" were delivered for domestic fuel, and this use increased by 55 percent from 263,981,000 gallons in 1945 to 408,625,000 in 1946. Important quantities of butane-propane mixtures are also used as raw material for the manufacture of chemicals, and the volume of this demand has expanded greatly from less than 40,000,000 gallons in 1943 to 131,288,000 in 1945 and 185,284,000 in 1946. Liquefied petroleum gases consumed as motor fuel are predominantly butane-propane mixtures. This particular demand showed a small decline in 1945 to 79,418,000 gallons; however, the 1946 quantity of 83,458,000 represents a new "peak" in the use of butane-propane mixtures as a motor fuel.

About 3 percent of the butane-propane mixtures sold is credited to manufactured-gas companies, and this demand has steadily increased in recent years to 19,779,000 gallons in 1946—a 25-percent gain over the 1945 total of 15,889,000 gallons. A similar proportion of "mixtures" is also used at present as fuel by industrial plants, and the 1946 quantity (19,982,000 gallons) compares with 16,038,000 under this classification in 1945. It should be added that much larger amounts (43,011,000 gallons in 1942) of butane-propane mixtures formerly were used as industrial fuel; however, lately there has been a shift to propane as competitive demands—domestic fuel and chemical raw material—have absorbed the supply. Butane-propane mixtures reported as synthetic rubber components are of minor importance in volume; however, the total increased from 404,000 gallons in 1945 to 865,000 in 1946.

The American Gas Association provided the following statistics regarding the distribution of liquefied petroleum gases by manufactured-gas companies:

Liquefied petroleum gas, as of May 1947, was being delivered through mains to 187,000 consumers in 306 communities by 157 companies in 36 states.

Butane-air gas and propane-air gas with heating value ranging from 520 to 1,600 B. t. u. per cu. ft. was supplied to 238 communities in 35 states.

A mixture of undiluted butane and propane gas with heating value of 2,800 to 3,000 B. t. u. per cu. ft. was supplied 17 communities in Arizona, California, and New Mexico.

Undiluted propane gas with heating value of 2,515 to 2,575 B. t. u. per cu. ft. was supplied 51 communities in Maryland, Massachusetts, Minnesota, Missouri, Nebraska, New Jersey, North Carolina, North Dakota, Virginia, and Wisconsin.

A survey covering sales of liquefied petroleum gases in the Pacific Coast marketing area (California, Oregon, Washington, Arizona, and Nevada) made by E. T. Knudsen of the Los Angeles office of the Bureau of Mines shows deliveries of 241,116,000 gallons in 1946—a gain of 29 percent over the 1945 quantity of 187,211,000 gallons. The liquefied petroleum gases marketed on the Pacific Coast made up about 14 percent of the national total in 1946 compared with a 15-percent share in 1945. Distributors operating in all other parts of the country sold 1,464,166,000 gallons of liquefied petroleum gases in 1946 or 34 percent over the 1945 volume of 1,089,555,000 gallons.

STOCKS

A rapid accumulation of total stocks from the opening level of 181,513 thousand gallons continued through the early months of 1946 to a peak of 308,385 thousand gallons on June 30. During this period product prices were relatively low and supply exceeded demand. The second half of 1946 was characterized by rising prices and growing demand accompanied by reduction of inventories to 209,209 thousand gallons at the year end.

Stocks at refineries were reduced 6 million gallons further in 1946 to the lowest level in recent years, an increase in natural gasoline being offset by declines in holdings of the other two groups of products.

An increase of 34 million gallons in stocks at plants and terminals resulted chiefly from the unusually large accumulation of natural gasoline in the first half of the year.

Stocks of natural gasoline and allied products in the United States, 1942–45, and 1946, by months, in thousands of gallons

Date	Natural gasoline		Liquefied petroleum gases		Other products		Total		
	At plants and terminals	At refineries	At plants and terminals	At refineries	At plants and terminals	At refineries	At plants and terminals	At refineries	Grand total
Dec. 31:									
1942	91,938	65,436	11,928	11,718	10,920	2,604	114,786	79,758	194,544
1943	61,488	68,922	15,750	29,274	10,332	4,956	87,570	103,152	190,722
1944	60,060	54,642	17,262	29,190	11,046	6,384	88,368	90,216	178,584
1945	67,412	34,314	22,255	17,262	22,840	17,430	112,507	69,006	181,513
1946									
Jan. 31	87,424	42,084	23,527	18,648	22,942	16,800	133,893	77,532	211,425
Feb. 28	112,413	45,822	24,747	22,638	23,442	16,338	160,602	84,798	245,400
Mar. 31	133,112	51,282	30,421	23,478	28,007	13,356	191,540	88,116	279,656
Apr. 30	143,292	56,868	28,158	27,048	24,632	13,230	196,082	97,146	293,228
May 31	143,496	65,058	24,619	22,344	27,828	10,836	195,943	98,238	294,181
June 30	156,092	67,662	26,528	20,622	29,291	8,190	211,911	96,474	308,385
July 31	164,254	64,302	19,895	19,278	29,450	10,836	213,599	94,416	308,015
Aug. 31	156,110	60,606	21,758	20,118	25,722	7,308	203,590	88,032	291,622
Sept. 30	150,305	62,580	24,148	18,984	31,461	9,030	205,914	90,594	296,508
Oct. 31	133,337	51,828	25,088	16,044	29,636	9,156	188,061	77,028	265,089
Nov. 30	112,446	42,588	24,762	8,904	29,102	12,642	166,310	64,134	230,444
Dec. 31	97,339	41,328	20,882	11,382	28,282	9,996	146,503	62,706	209,209

PRICES

The Mid-Continent (Group 3) price of the 26–70 grade of natural gasoline declined rapidly from a January 1, 1946, level of 4.5 cents a gallon to 2.75 cents late in February. Gradual price improvement began in early May and continued through the remainder of the year to a closing price of 5.0 cents a gallon. The old ceiling price of 4.75 cents a gallon, eliminated in October with liquidation of the wartime Office of Price Administration, was penetrated for the first time late in November, when sales at 4.875 cents were reported. The yearly average price declined from 4.56 cents in 1945 to 3.84 cents in 1946.

The Oklahoma spot price of 73–75 octane motor gasoline declined from a January 1946 average of 5.72 cents a gallon to 5.50 cents in March and thereafter improved steadily to an average of 7.25 cents in December to average 6.31 cents a gallon for the year, compared with 5.89 cents in 1945. The 7-percent rise in this average in 1946 over 1945 contrasts with the 16-percent drop in average price of the related product—natural gasoline.

The marginal character of natural-gasoline markets is emphasized by the disparity in price trends between natural gasoline and motor fuel in Oklahoma in 1945 and 1946. Although the direction of change of the two series is usually the same, the relative magnitude of changes varies widely, the motor-fuel average tending to minimize declines in soft markets and to respond more promptly and vigorously to firmer market conditions.

The average value at the plants of light products, except liquefied petroleum gases, was 4.16 cents a gallon in 1946, compared with 4.42 cents in 1945. The average value of liquefied petroleum gases declined from 2.97 cents a gallon to 2.58 cents.

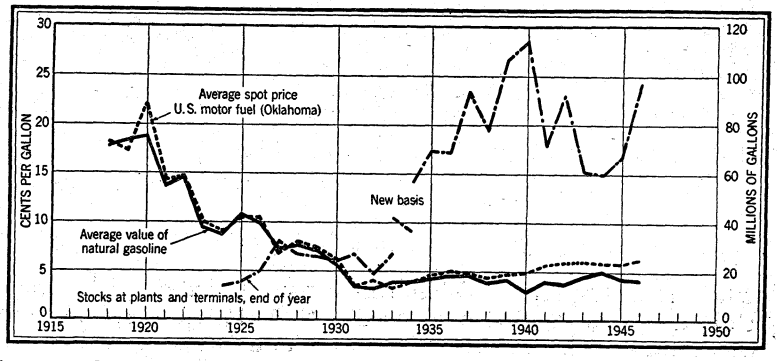

FIGURE 2.—Trends in average value of natural gasoline, spot price of gasoline, and stocks of natural gasoline, 1918–46.

FOREIGN TRADE [3]

Shipments to foreign countries, particularly of natural gasoline, increased abruptly after the first quarter of 1946 and were maintained at a high rate through December. Natural-gasoline exports increased 249 percent over 1945 to 128,868 thousand gallons valued at $7,507,000, compared with 36,912 thousand gallons valued at $2,293,000 in 1945. The quantities shipped in 1946 to principal countries of destination, in thousands of gallons were: United Kingdom 67,333, Canada 53,661, France 4,029, and Portugal 2,112.

Exports of liquefied gases, originating at plants of the natural-gasoline industry and at petroleum refineries, amounted to 49,091 thousand gallons valued at $3,319,000 in 1946 compared with 26,059 thousand gallons valued at $1,589,000 in 1945. The principal countries of destination in 1946 were Canada and Mexico, although France is shown to have received an initial item of 1,941 thousand gallons.

Liquefied petroleum gases exported from the United States, 1942–46, by countries, in thousands of gallons [1]

Country	1942	1943	1944	1945	1946
Bermuda	64	59	86	103	147
Brazil	71			63	289
Canada	3,501	4,499	7,507	15,044	30,379
France					1,941
Mexico	4,548	5,374	6,743	10,615	15,955
Philippines, Republic of the				12	101
Portugal	114	54	64	97	79
Other countries	87	76	157	125	200
Total	8,385	10,062	14,557	26,059	49,091

[1] Converted from pounds to gallons at 4.5 pounds per gallon.

[3] Figures on exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Nickel

By HUBERT W. DAVIS

GENERAL SUMMARY

DESPITE a 17-percent decline in consumption of nickel in the United States in 1946 compared with 1945, a peacetime record was established. Strikes in the steel and automotive industries were partly responsible for the smaller consumption in 1946. As a consequence of the lessened use of nickel in 1946, output in Canada was substantially less than in 1945; but production in Cuba, the second-largest source of supply for the United States, was at a rate slightly higher. Domestic output of nickel was, as heretofore, small in 1946.

Salient statistics for nickel, 1942–46

	1942	1943	1944	1945	1946
United States:					
Production:					
Primary ---- short tons	612	642	988	1,155	352
Secondary ---- do	4,142	6,917	4,321	6,483	8,248
Imports (gross weight)[1] ---- do	132,954	141,249	134,932	122,528	104,734
Exports (gross weight)[2] ---- do	7,096	9,464	7,931	3,876	7,977
Price per pound [3] ---- cents	31½	31½	31½	31½	31½–35
Canada:					
Production ---- short tons	142,606	144,009	137,299	122,565	94,833
Imports ---- do	499	545	424	762	(4)
Exports ---- do	138,795	135,547	133,599	108,222	111,939
World production (approximate) ---- do	182,000	190,000	180,000	169,000	140,000

[1] Excludes "All other manufactures of nickel"; weight not recorded.
[2] Excludes "Manufactures"; weight not recorded.
[3] Price quoted by International Nickel Co., Inc., for electrolytic nickel in carlots f. o. b. Port Colborne, Ontario, including duty of 2½ cents a pound.
[4] Not available.

The steel industry continued to be the chief consumer of nickel in the United States. The largest single outlet for nickel in the steel industry in 1946 was for chromium-nickel stainless steels, which used nearly 36,000,000 pounds. The triple-alloy steels containing nickel, chromium, and molybdenum, which came into prominence during the war, continued to absorb substantial quantities of nickel in 1946. Usage of nickel by electroplaters and in the production of nickel-silver was greater than prewar. In 1946 the United States resumed minting the 5-cent piece containing one-fourth nickel.

Imports of nickel in all forms were about 14 percent less than in 1945.

Effective November 25, 1946, the International Nickel Co., Inc., advanced its contract price for electrolytic nickel in the United States to 35 cents a pound, f. o. b. Port Colborne, Ontario, inclusive of the import duty of 2½ cents a pound; the previous price was 31½ cents a pound.

PRODUCTION

Domestic production of nickel is small and comprises metals recovered from scrap-nickel anodes, nickel-silver, and copper-nickel alloys (including Monel metal), and primary nickel recovered in copper refining and produced from ore and as a byproduct of talc production, as listed in the accompanying table. Domestic primary nickel was recovered in 1946 as a byproduct in copper refining at Baltimore, Md.; Carteret and Perth Amboy, N. J.; Laurel Hill, N. Y.; and Tacoma, Wash. Although all the nickel recovered as a byproduct of copper refining is credited to domestic production, some of it is recovered from imported blister copper. Missouri, a small producer in 1945, reported no commercial output in 1946.

Nickel produced in the United States, 1942–46

Year	Primary (short tons)[1]		Secondary [2]	
	Byproduct in copper refining [3]	Other [4]	Short tons	Value
1942	612	----------	4,142	$2,899,400
1943	642	----------	6,917	4,841,900
1944	697	291	4,321	3,024,700
1945	[5] 1,155	(5)	6,483	4,538,100
1946	352	----------	8,248	5,801,600

[1] Bureau of Mines not at liberty to publish value.
[2] Nickel recovered as metal and in alloys and salts.
[3] Nickel content of nickel salts and metallic nickel.
[4] Nickel content of concentrates and matte produced from ore and of concentrates produced as byproduct of talc.
[5] Production from "Other" included under "Byproduct in copper refining." Bureau of Mines not at liberty to publish figures separately.

CONSUMPTION AND CONSUMERS' STOCKS

The accompanying tables give data on consumption and consumers' stocks of nickel. The data cover all known consumers of nickel in the form of primary, secondary, and oxide. The figures for nickel salts, however, fall short of the total; nevertheless, they cover almost all of the larger and many of the smaller users of nickel in this form.

Nickel (exclusive of purchased and home scrap) consumed and in stock in the United States, 1945–46, by forms, in pounds of nickel

Form	1945			1946		
	Consumption	Stocks at consumers' plants Dec. 31	In transit to consumers' plants Dec. 31	Consumption	Stocks at consumers' plants Dec. 31	In transit to consumers' plants Dec. 31
Primary	153,235,789	[1] 12,744,749	566,383	122,292,187	16,581,310	834,059
Secondary (remelted from scrap)	[2] 7,906,606	[1] 103,495	2,000	154,717	32,472	----------
Oxide	11,035,457	[1] 1,458,265	230,375	17,696,534	2,162,323	749,950
Matte	19,809,007	3,409,699	----------	19,115,689	5,975,787	----------
Mayari iron ore	100	262,125	----------	----------	255,630	----------
Salts	509,108	[1] 401,056	228	951,647	399,797	842
Nickel-cobalt compound	8,681	3,569	----------	(3)	(3)	(3)
	192,504,748	[1] 18,382,958	798,986	160,210,774	25,407,319	1,584,851

[1] Revised figure. [2] Includes an undetermined quantity of scrap. [3] Not available.

Nickel (exclusive of purchased and home scrap) consumed in the United States, 1945–46, by uses

Use	Pounds of nickel	
	1945	1946
Ferrous:		
Stainless steels	111,114,967	35,986,164
Other steels		31,193,998
Cast irons	6,025,564	5,973,919
Nonferrous (comprises copper-nickel alloys, nickel-silver, brass, bronze, beryllium, magnesium, and aluminum alloys, and Monel, Inconel, and malleable nickel)	52,802,013	51,819,728
High temperature and electrical resistance alloys	7,902,392	13,596,601
Electroplating:		
Anodes	12,736,349	17,059,306
Solutions		1,542,750
Catalysts	890,253	544,093
Ceramics	43,042	387,655
Other	990,168	2,106,560
	192,504,748	160,210,774

FOREIGN TRADE[1]

The quantity of nickel imported into the United States in 1946 was 14 percent smaller than in 1945 and 25 percent less than in the peak year 1943. Imports comprised chiefly metallic nickel, matte, and oxide. As heretofore, Canada was the chief source of the imports; it supplied 141,433,524 pounds of metallic nickel, 38,092,080 pounds of Monel matte (averaging about 55 percent nickel and 25 percent copper), 1,352,021 pounds of oxide (averaging about 76 percent nickel), and 2,050 pounds of nickel-silver. At the plant of the International Nickel Co., Inc., Huntington, W. Va., the Monel matte was refined to Monel metal and other products. Refining of nickel pig at the Huntington works was discontinued early in 1946; consequently, only 74 short tons were produced from Canadian washed sulfide and oxide, and none was produced from New Caledonian matte. In 1946 Cuba furnished 27,689,919 pounds of oxide (averaging 77 percent nickel), the United Kingdom and Norway supplied 881,330 and 9,999 pounds, respectively, of metallic nickel, and Switzerland furnished 182 pounds of metallic nickel and 7,712 pounds of nickel-silver.

The nickel content of the unmanufactured nickel products imported into the United States is estimated at 184,272,000 pounds in 1946, compared with 214,866,000 pounds in 1945.

Exports of nickel comprise largely products manufactured from imported raw materials. Exports of alloys and scrap were 2½ times more than in 1945, those of nickel-silver nearly 8 times greater, and those of metallic nickel were 17 percent larger. Exports of nickel-chrome electric resistance wire were 16 percent less.

The United Kingdom (8,069,726 pounds), Canada (2,752,208 pounds), and France (471,084 pounds) were the chief markets for nickel, Monel metal, alloys, and scrap in 1946.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Nickel products (excluding residues) imported for consumption in the United States, 1944–46, by classes

Class	1944		1945		1946	
	Pounds	Value	Pounds	Value	Pounds	Value
Unmanufactured:						
Nickel ore and matte	72,828,746	$11,713,123	50,077,170	$8,223,086	38,092,080	$5,263,584
Nickel pigs, ingots, shot, etc	186,104,935	48,144,356	156,804,166	42,813,780	142,324,523	38,657,205
Nickel bars, rods, tubes, etc	300	598	51	56	512	960
Nickel oxide	10,929,012	2,079,897	38,174,845	7,727,872	29,041,940	5,927,731
Manufactured:						
Nickel-silver or German silver in sheets, strips, rods, and wire	291	198	408	194	9,762	4,697
All other manufactures of nickel	(1)	551,530	(1)	122,670	(1)	3,529
		62,489,702		58,887,658		49,857,706

[1] Quantity not recorded.

Nickel products exported from the United States, 1944–46, by classes

Class	1944		1945		1946	
	Pounds	Value	Pounds	Value	Pounds	Value
Ore, concentrates, and matte	1,521	$1,005	15	$38	21,083	$12,832
Alloys and scrap containing nickel (including Monel metal)	8,041,351	2,315,944	4,573,476	1,502,874	11,194,004	4,005,090
Metal in ingots, bars, sheets, etc	6,892,221	3,011,097	1,614,045	740,088	1,883,881	994,470
Manufactures	(1)	1,249,340	(1)	824,322	(1)	647,736
Nickel-chrome electric resistance wire	477,476	793,052	971,549	1,384,044	817,003	1,247,861
Nickel-silver or German silver, crude, scrap, or bars, rods, etc	104,539	56,287	267,145	68,972	2,037,788	500,132
Nickel salts and compounds	345,682	124,651	326,749	105,469	(2)	(2)
		7,551,376		4,625,807		7,408,121

[1] Quantity not recorded.
[2] Beginning January 1, 1946, not separately classified.

WORLD REVIEW

The accompanying table shows world production of nickel by countries, 1939–46, insofar as statistics are available. Despite the fact that nickel is produced in many countries, four—Canada, Cuba, New Caledonia, and the U. S. S. R.—account for about nine-tenths of world output, and one country—Canada—supplies 70 to 75 percent of the total.

World production of nickel (content of ore), 1939–46, by countries, in metric tons[1]

[Compiled by B. B. Mitchell]

Country[1]	1939	1940	1941	1942	1943	1944	1945	1946
Australia		(2)	(2)	(2)				
Brazil	25	(2)	(2)	1		6	(2)	(2)
Burma	921	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Canada	102,559	111,383	128,029	129,369	130,642	124,555	111,189	86,031
Cuba				(2)	2,430	4,679	10,900	11,241
Finland	(2)	(2)	97	1,630	8,970	313	3,700	(2)
Germany	500	729	674	577	(2)	(2)	(2)	(2)
Greece	1,336	575	185	706	495	(2)	(2)	
Iran		[3] 21	[3] 9	[3] 7	(2)	(2)	[3] 5	(2)
Italy	[4] 100	[4] 87	[4] 91	[4] 74	(2)	(2)	(2)	(2)
Japan[5]	876	825	2,311	1,252	1,613	1,720	650	(2)
Netherlands Indies	[4] 753	2,222	(2)	(2)	(2)	(2)	(2)	(2)
New Caledonia	10,625	10,535	10,395	9,415	7,374	8,115	4,328	2,779
Norway	1,106	1,007	907	911	577	529	55	(2)
Southern Rhodesia	[4] 490	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Sweden			101	377	702	698	390	
Union of South Africa	398	416	581	449	343	481	499	483
U. S. S. R. (estimate)	(2)	8,650	(2)	(2)	11,160	(2)	13,400	(2)
United States[6]	357	503	599	555	582	896	1,048	319
Total (estimate)	122,000	140,000	162,000	165,000	172,000	163,000	153,000	127,000

[1] In addition to countries listed Egypt and French Morocco produce nickel, but data of output are not available.
[2] Data not yet available; estimate included in total.
[3] Fiscal year ending Mar. 20 of year stated.
[4] Estimate.
[5] Preliminary data for fiscal year ended March 31 of year following that stated.
[6] Byproduct in electrolytic refining of copper. In 1941 includes also production from ore and as byproduct of talc; in 1944 and 1945 includes also production from ore.

Canada.—Virtually all the Canadian output is derived from copper-nickel ores of the Sudbury district, Ontario. Some nickel is also recovered as a byproduct from silver-cobalt ores of Cobalt and other areas in northern Canada. Two companies—International Nickel Co. of Canada, Ltd., and Falconbridge Nickel Mines, Ltd.—are the principal producers. Nickel production in Canada was 94,833 short tons in 1946, compared with 122,565 tons in 1945.

Sales of nickel in all forms by the International Nickel Co. of Canada, Ltd., were 201,103,234 pounds in 1946 compared with 201,572,987 pounds in 1945.[2] Ore mined was 7,736,334 short tons in 1946 compared with 10,136,350 tons in 1945. Mining and smelting operations were about 50 percent of capacity during the first half of 1946; but beginning in September they were progressively expanded, and by the year end the rate of production was 75 percent of the maximum wartime figure. Underground development totaled 48,673 feet in 1946, bringing the total footage to 1,184,718 at the year end. Proved ore reserves at the end of 1946 were 217,142,000 short tons containing 6,861,000 tons of nickel-copper, compared with 217,373,000 tons containing 6,866,000 tons of nickel-copper at the end of 1945. As a result of intensive research by the International Nickel Co. during recent years, nickel oxide sinter, a new product to be offered to steel manufacturers, is to be made at a plant under construction at Copper Cliff, Ontario. The operations and plants of the International Nickel Co. of Canada, Ltd., have been described in detail in the Canadian Mining Journal.[3]

[1] International Nickel Co. of Canada, Ltd., Annual Report: 1946, 15 pp.
[2] Canadian Mining Journal, vol. 67, No. 5, May 1946, pp. 309–554.

Falconbridge Nickel Mines, Ltd.,[4] operated only its smaller blast furnace from January 9 to December 18, 1946, with the larger furnace operating alone before and after that period. As a result of the reduced operations, only 486,516 short tons of ore were treated in 1946 (716,868 tons in 1945), and 12,780 tons of matte (19,470 tons in 1945) were produced. The matte averages about 53 percent nickel. Ore reserves were 14,205,500 tons averaging 1.73 percent nickel on December 31, 1946.

During 1946 much publicity was given to the nickel-copper discoveries in the Lynn Lake area of northern Manitoba, where Sherritt Gordon Mines, Ltd., began a program of exploration and development.

Cuba.—Despite equipment repairs and other adverse factors, production of nickel in Cuba by the Nicaro Nickel Co. was greater than in 1945. Output of oxide was 16,040 short tons (12,391 tons nickel content) in 1946 compared with 15,425 tons (12,015 tons nickel content) in 1945. Exports of nickel oxide from Cuba were 13,953 short tons (10,742 tons nickel content) in 1946 compared with 16,326 tons (12,625 tons nickel content) in 1945.

New Caledonia.—New Caledonia was surpassed by Cuba as a producer of nickel in 1945 and 1946. Production of ore was 107,944 metric tons (averaging 2.5 to 3.25 percent nickel) in 1946 compared with 123,643 tons in 1945. The 1946 output comprised 65,084 and 32,155 tons, respectively, from the Thio and Voh properties of Société le Nickel and 10,705 tons from the Good Luck concession at Mont Dore of Henri Lafleur. All ore extracted in 1946 was sent to the smelter of Société le Nickel at Noumea, where a matte containing 76 to 78 percent nickel is produced. In 1946 output of matte was 1,783 metric tons and exports were 3,025 tons. The matte was shipped to the company works at Le Havre, France, for refining.

Norway.[5]—The Falconbridge nickel refinery at Kristiansand was operated continuously during 1946 with gradually increasing production, and by the year end the accumulation of matte was reduced to about normal level. Output of nickel was 10,035,152 pounds in 1946.

Venezuela.—Sampling of nickel-ore deposits near Tinaquillo by engineers of International Nickel Co. has been completed, and the future of the region depends on results obtained by research metallurgists in treating the ore in a pilot plant.[6] The Venezuelan nickeliferous deposits, including those at Lomo de Hierro, have been described briefly by Davey.[7]

[4] Falconbridge Nickel Mines, Ltd., 18th Annual Report: 1946, 12 pp.
[5] Falconbridge Nickel Mines, Ltd., 18th Annual Report: 1946, pp. 2, 10.
[6] Engineering and Mining Journal, vol. 147, No. 9, September 1946, p. 128.
[7] Davey, J. C., The Venezuelan Andes and the Coastal and Interior Ranges: Mining Mag. (London), vol. 76, No. 2. February 1947, pp. 73–75.

Nitrogen Compounds

By BERTRAND L. JOHNSON[1]

GENERAL SUMMARY

THE great military demand for nitrogen for munitions collapsed following the conclusion of major hostilities in 1945. Several Government-owned synthetic nitrogen plants were closed, and most were declared surplus. Agriculture and industry were unable to absorb the increased supplies of nitrogen compounds, and production trended downward toward domestic peacetime levels. However, recognition of a great world shortage in nitrogen soon caused a reversal of this trend. Demand from famine-threatened countries and from the Army for nitrogenous fertilizers for use in the occupied territories increased. Late in 1946 the Army reactivated its four remaining synthetic nitrogen plants and borrowed large quantities of ammonium nitrate from the domestic industry for immediate shipment abroad. Operation of inactive privately owned and leased Government plants was resumed. At the end of 1946 there was still a world nitrogen shortage. Estimated supplies for 1947 are expected to be over three-quarters of a million tons below needs, and it was anticipated that international allocation of world supplies of nitrogenous fertilizers would continue through the 1947–48 season. In the United States the production of chemical nitrogen is reported to have fallen short of domestic needs. Shortages appeared in the output of byproduct ammonium sulfate, and the imports of Chilean nitrate were below schedule.

Salient statistics of nitrogen compounds produced in the United States, 1944–46, in short tons

	1944	1945	1946
Production:			
Ammonia (NH_3):			
Synthetic plants: Anhydrous ammonia [1]	543,651	548,655	725,537
Byproduct coking plants (NH_3 content):			
Aqua ammonia	31,665	27,607	24,991
Ammonium sulfate	204,561	191,073	160,938
Total	236,226	218,680	185,929
Ammonium sulfate:			
Synthetic plants	88,000	(2)	(2)
Byproduct coking plants	818,244	764,293	643,752

[1] Data from Bureau of the Census monthly Facts for Industry series; they represent all known commercial plants manufacturing synthetic anhydrous ammonia and one Tennessee Valley Authority plant, but exclude consideration of other Government-owned plants. Ten plants reported in 1944 to May 1946 and 12 plants in June to December; the 2 additional plants were included after their status changed from military to commercial

[2] Figure not available.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Salient statistics on nitrogen compounds imported into and exported from the United States, 1943–46, in short tons

	1943	1944	1945	1946
Imports:				
Industrial chemicals:				
Anhydrous ammonia	5,863	----------	4	7
Ammonium nitrate	53,256	(1)	(1)	----------
Fertilizer materials:				
Ammonium sulfate	99,827	103,628	118,890	101,558
Calcium cyanamide	125,634	101,886	141,057	163,093
Ammonium nitrate mixtures containing 20 percent or more nitrogen	2,895	317	655	1,105
Nitrogenous materials, n. s. p. f.	63,372	112,616	135,010	126,029
Ammonium phosphates	43,987	91,943	92,757	91,113
Sodium nitrate	761,165	713,004	849,888	529,677
Sodium-potassium nitrate	19,767	9,407	----------	4,400
Exports:				
Industrial chemicals:				
Anhydrous ammonia	1,983	3,623	4,312	6,159
Aqua ammonia	6,812	2,499	2,715	(2)
Ammonium nitrate	9,534	13,454	9,845	(2)
Fertilizer materials:				
Ammonium sulfate	78,005	10,615	20,752	25,256
Calcium cyanamide	----------	(1)	(1)	(2)
Nitrogenous chemical materials, n. e. s.	13,215	11,175	83,974	(2)
Sodium nitrate	6,740	11,597	12,229	16,180

[1] Less than 1 ton.
[2] Beginning Jan. 1, 1946, not separately classified by U. S. Department of Commerce.

INORGANIC NITROGEN COMPOUNDS

NATURAL NITRATES

Domestic Nitrate Deposits.—Deposits of soluble nitrate minerals occur scattered throughout the United States, and many have been described (see Nitrogen Compounds chapter, Minerals Yearbook, 1942, p. 1522). However, none of the deposits has yet proved of sufficient size or grade to serve as a basis for a domestic nitrate industry; consequently little attention has been paid to them in recent years.

Chilean Nitrate.—Large quantities of natural sodium nitrate continue to be imported from Chile, but the amounts brought into this country in 1946 were much below those entering in 1945, because a large tonnage was diverted from the United States to other markets. Only a little over half a million tons were brought into the United States, the smallest quantity in several years. No Chilean sodium-potassium nitrate was imported into this country in 1945, but in 1946 a few thousand tons were received. The imports of these two commodities for 1942–46 are shown in the accompanying tables.

Prices of imported sodium nitrate (minimum nitrogen content, 16 percent) were covered, at the wholesale level, from January 1, 1946, to July 27, 1946, by Office of Price Administration Revised Maximum Price Regulation 205 and Amendment 4 to that regulation. The maximum delivered price at any destination continued at $30 per ton in bulk (carlot quantities, f. o. b. cars at Atlantic, Gulf, and Pacific ports) plus specified freight, truck loading, and terminal use charges. For nitrate of soda-potash (minimum nitrogen content 14 percent), the base maximum delivered price at any destination was $38 per ton in bulk, plus the same additions as for sodium nitrate. Amendment 12 to RMPR 205, effective July 27, 1946, increased the maximum price

of imported nitrate of soda to $35.50 per ton and nitrate of soda-potash to $43.50 per ton in bulk, f. o. b. cars at importer's port warehouse from which delivery is made. These increases of $5.50 per ton were made to meet the higher prices asked by Chilean suppliers because of removal of the subsidy and increased costs of production and transportation.

On November 10, 1946, imported sodium nitrate and nitrate of soda-potash were exempted from price control (OPA Supplementary Order 193, issued November 12, 1946, effective November 10, 1946).

It has been reported that installation of a solar evaporation process is to be started in the Chilean nitrate field in 1947 to permit recovery of a large tonnage of potassium nitrate and other products from leaching solutions now discarded. The operators believe that this by-product recovery will help the nitrate industry compete more successfully with the synthetic-nitrate producers.

Sodium nitrate and sodium-potassium nitrate imported for consumption in the United States, 1942–46 [1]

Year	Sodium nitrate		Sodium-potassium nitrate		Year	Sodium nitrate		Sodium-potassium nitrate	
	Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
1942	899,150	$17,183,425	14,272	$377,703	1945	849,888	$18,558,959	------	------
1943	761,165	15,188,787	19,767	580,760	1946	529,677	11,448,232	4,400	$146,312
1944	713,004	15,346,426	9,407	278,534					

[1] All from Chile except sodium nitrate in 1942 as follows: Canada, 5 tons, $259; Mexico, 55 tons, $2,386.

SYNTHETIC NITROGEN COMPOUNDS

Ammonia and Its Compounds.—Early in 1945, 10 Government-owned synthetic ammonia plants—the 8 Ordnance plants and those of the Tennessee Valley Authority and the Defense Plant Corporation—and several private plants were producing synthetic ammonia. Following cessation of hostilities in that year, several Ordnance plants (Ohio River, Dixie, Buckeye, Jayhawk, Ozark, Cactus, and Morgantown) and the Defense Plant Corporation operation at Lake Charles, La., were declared surplus and advertised for sale or lease. The War Assets Administration disposed of 5 of the surplus synthetic ammonia plants in 1946—2 were sold and 3 leased. The Cactus and Ohio River plants were withdrawn from surplus and returned to the War Department. These 2 plants and the Missouri and Morgantown Ordnance plants were later operated by the Army (in coordination with nitric acid and ammonium nitrate facilities in the other Ordnance plants) to begin production of an expected total of 330,000 tons of nitrogen for fertilizers during 1946–47 for export to occupied areas.

Further data regarding these plants and the Ordnance plants producing nitric acid and ammonium nitrate are contained in recent reports.[2] According to the War Assets Administration—

[2] Anderson, Clinton P., Federally Owned Plants and Facilities: 79th Congress, 2d Sess., Senate Document 167, 1946, 93 pp.
War Assets Administration, The Disposal of Synthetic Ammonia Plants: 4th Suppl. Rept. to the Congress on Chemical Plants and Facilities, Oct. 31, 1946, 10 pp.

The total rated synthetic fixed nitrogen capacity of the United States now in private hands, including the five Government plants disposed of to private interests, is 797,100 tons. In addition, by-product nitrogen capacity of about 260,000 tons, together with net imports, production at TVA and other sources amounting to about 75,000 tons, bring the total potential domestic availability to approximately 1,238,000 tons.

Interest in the need for nitrogenous fertilizers for occupied areas appeared early in the spring of 1946, and the Army unsuccessfully attempted to obtain needed supplies in the civilian market. It thereupon obtained authorization to put some of the nitrate plants back into operation to produce the needed fertilizer. This program was put into effect in July 1946 by reactivating 4 Government-owned ammonia plants and 11 other facilities needed to produce solid ammonium nitrate. Several months were required to get the plants back into production, and the first ammonium nitrate was obtained from them in November 1946. By the end of the year, 11,000 tons of ammonium nitrate were reported to have been produced. Meanwhile, the Army borrowed 110,000 tons of ammonium nitrate (33,000 tons of contained nitrogen) from commercial sources for shipment to occupied areas. This was to be repaid in kind from the production of the munitions plants.

Synthetic Sodium Nitrate.—The synthetic sodium nitrate consumed in the United States in 1946 was produced domestically. There were no imports. The domestic production came from a single unit—the Hopewell, Va., plant of the Allied Chemical & Dye Corp. Little information is available regarding current production or utilization of domestically-produced synthetic sodium nitrate. The Civilian Production Administration, however, stated that the synthetic and by-product sodium nitrate delivered from July 1945 through January 1946 contained 18,800 tons of nitrogen. It was reported that domestic production of synthetic sodium nitrate in 1946 was hampered by a shortage of soda ash.

Prices of synthetic sodium nitrate continued under revised OPA Maximum Price Regulation 205. Amendment 12 of July 27, 1946, which permitted a rise in the price of imported sodium nitrate, did not change the price of the domestic product. Quotations remained at $27 per ton for crude in bulk, f. o. b. production point. On November 10, 1946, OPA decontrolled sodium nitrate prices, and on January 1, 1947, the Barrett Division, Allied Chemical & Dye Corp., announced new prices ($32 per ton in bulk, carlots, f. o. b. Hopewell, Va.) for the domestic "Arcadian" nitrate of soda.

ORGANIC MATERIALS

War Food Administration Order 105, Amendment 1, which controlled the acquisition of oilseed meals for fertilizer purposes during the first half of the year, was terminated August 5, 1946, by the United States Department of Agriculture; but, owing to a shortage of proteins for feeding purposes, restrictions upon the acquisition and use of edible oilseed meals for fertilizer purposes were continued by addition of Amendment 10 to War Food Order 9 as of that date. War Food Order 9, as amended, was terminated October 17, 1946.

Peat

By J. A. CORGAN AND GOLDEN V. CHIRIACO

GENERAL SUMMARY

PEAT production in the United States in 1946 totaled 140,707 short tons, according to reports received by the Bureau of Mines. This figure represents an increase of 31 percent over the estimated 1945 output of 107,000 tons (revised) and is substantially greater than the previous peak production of 107,261 tons recorded for 1918. The total value of the peat produced in 1946 was $1,006,231 compared with an estimated $821,000 (revised) in 1945.

Imports of peat moss, which have been steadily increasing since 1940, amounted in 1946 to 84,078 short tons, an increase of 7 percent over the 1939 prewar figure of 78,611 tons and 8 percent over imports in 1945. As in the past, no exports of peat were reported, making the quantity available for domestic consumption in 1946 224,785 tons. Approximately 95 percent of the peat sales in 1946 was for soil improvement and for manufacture of mixed fertilizers.

Reserves.—Peat, an integral part of the natural resources of the country, is found in about half of the States. An estimate of 13,827,000,000 tons has been calculated as air-dried peat.[1]

Minnesota, Wisconsin, and Michigan combined contain 75 percent of the reserves; 14 percent of the country's total is in Florida, and the rest is distributed through the New England and Pacific Coast States.

PRODUCTION

Fifty-nine producers operating in 20 States accounted for the 1946 production of 140,707 short tons. Although eight plants reported that they were closed down permanently in 1946, eight of those "inactive" in 1945 reported production for 1946. A number of plants still reported "idle," but some of these planned to reopen in 1947. High wages and inability to procure labor continued to be the principal reasons for plant inactivity, according to reports received from producers.

[1] Soper, E. K., and Osbon, C. C., The Occurrence and Uses of Peat in the United States: Geol. Survey Bull. 728, 1922, p. 92.

The average value per ton in 1946 was $7.15, a 7-percent decrease from the 1945 value of $7.67. Production and value for 1944–46 are shown in the accompanying table.

Peat produced in the United States, 1944–46

Year	Short tons	Value	
		Total	Average per ton
1944	[1] 97,000	[1] $878,000	$9.05
1945	[1] 107,000	[1] 821,000	7.67
1946	140,707	1,006,231	7.15

[1] Estimated. Revised to include estimates for producers reporting in 1946 but not in 1944–45.

Maine was the highest peat-producing State in 1946, followed, in order of output, by New Jersey, Florida, Ohio, Illinois, Michigan, California, New York, Minnesota, Connecticut, Georgia, Wisconsin, Iowa, Pennsylvania, Texas, Washington, Massachusetts, Indiana, Colorado, and New Hampshire.

Peat humus, produced in 12 States, comprised 38 percent of the total production in 1946; reed or sedge, produced in 12 States, 33 percent; and moss peat and other, produced in 13 States, 29 percent.

USES

Peat has been used most widely for many years in this country for soil improvement. Of the sales reported in 1946, 72 percent was used for soil improvement, 23 percent for mixed fertilizers, and 5 percent for other purposes, including litter for barns and poultry yards, improvement of lawns and golf courses, in nurseries and greenhouses, and as packing material for plants, fruits, vegetables, eggs, and other fragile articles. No sales of peat for fuel were reported for 1946. In some European countries peat is used extensively for fuel and power purposes; in this country, however, peat has not been able to compete successfully in the fuel market because of ample supplies of higher-grade fuels available at reasonable cost.

United States Government Specifications.—The Federal Government purchases a certain amount of peat, provided the peat meets required specifications. These specifications may be obtained from the Bureau of Federal Supply, United States Treasury Department, Washington 25, D. C.

IMPORTS [2]

Imports in 1946—all from Canada and the Netherlands—totaled 84,078 short tons valued at $2,704,803. Before 1939 most of the peat imported came from Germany. In 1938 Germany supplied 36,381 tons, valued at $525,564; in the same year the Netherlands and Sweden together supplied 21,836 tons valued at $348,252.

The average value per short ton of imported peat was $32.17 in 1946 compared with $30.81 in 1945.

Peat moss imported for consumption in the United States, 1942–46

Year	Short tons	Value	Year	Short tons	Value
1942	49,236	$1,219,473	1945	77,673	$2,393,214
1943	59,427	1,577,388	1946	84,078	2,704,803
1944	64,383	1,916,794			

Peat moss imported for consumption in the United States, 1944–46, by countries

Country	Poultry and stable grade					
	1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value
Canada	36,979	$1,161,935	44,289	$1,465,531	42,536	$1,484,118
Netherlands					496	14,016
	36,979	1,161,935	44,289	1,465,531	43,032	1,498,134

Country	Fertilizer grade					
	1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value
Canada	27,404	$754,859	33,384	$927,683	40,452	$1,191,243
Netherlands					594	15,426
	27,404	754,859	33,384	927,683	41,046	1,206,669

[2] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

WORLD PRODUCTION

Unsettled economic conditions throughout the world make it difficult to obtain complete data on the production of peat in foreign countries. The latest available statistics are given in the accompanying table.

World production of peat, 1940–46, by countries, in metric tons [1]

[Compiled by B. B. Mitchell]

Country [1]	1940	1941	1942	1943	1944	1945	1946
Canada:							
Fuel	27	322	156	709	584	107	132
Peat moss	15,591	25,222	48,540	58,386	72,979	76,170	79,060
Denmark	2,500,000	4,700,000	4,800,000	6,200,000	5,800,000	5,685,000	3,700,000
Eire [2]	[3] 3,624,250	5,398,274	4,312,738	4,954,895	5,302,477	5,086,734	(4)
Finland	13,716	10,982	8,659	2,364	2,840	7,280	(4)
France	23,880	83,560	209,740	190,210	112,619	92,000	78,000
Hungary	10,290	11,720	16,710	28,640	(4)	(4)	(4)
Iceland	24,344	18,003	(4)	11,560	11,973	11,000	[5] 10,500
Italy	9,433	19,510	134,463	[6] 59,204	(4)	(4)	(4)
Netherlands	616,640	748,810	712,935	648,800	535,550	386,050	571,940
Norway	(4)	127,000	185,000	(4)	(4)	(4)	(4)
Sweden:							
Fuel	76,367	248,297	637,568	978,269	810,000	1,150,000	703,000
Litter, baled	123,201	118,599	112,400	110,000			
Litter and "Mull," unbaled	6,000	3,649	2,060	1,395	107,000	100,000	106,000
"Mull," baled	25,543	26,420	14,987	15,948			
Switzerland	12,000	[5] 40,000	[5] 200,000	[5] 430,000	[5] 310,000	497,429	100,000
U. S. S. R. [7]	[5] 31,800,000	(4)	(4)	(4)	(4)	[5] 19,760,000	(4)
United States [8]	64,000	78,000	65,000	54,000	88,000	97,000	127,647

[1] In addition to countries listed, Argentina, Austria, Germany, and Poland produce peat, but data of production are not available.

[2] Figures for 1940–42 relate to production by holders of agricultural land only; those for 1943–46 cover total production.

[3] Fiscal year ended April 30 of year stated.

[4] Data not available.

[5] Estimate.

[6] January to June, inclusive.

[7] Excluding Estonia, Latvia, and Lithuania.

[8] Data for 1940–43 are as reported to the Bureau of Mines by producers and probably represent only about two-thirds of total production. Data for 1944–45 have been revised to provide estimates believed to represent, as does 1946, reasonably complete coverage.

Petroleum and Petroleum Products[1]

By A. G. WHITE, F. S. LOTT, J. C. CASPER, A. T. COUMBE, AND A. L. CLAPP

	PAGE
General summary	870
Salient statistics	872
Reserves	877
World oil supply	877
Crude petroleum	879
Supply and demand	879
Production	879
General	879
By States	885
Wells	904
Consumption and distribution	907
Stocks	916
Prices and value	921
Refined products	923
General review	923
Aviation gasoline	934
Refined products—Continued	
Motor fuel	936
Production	938
Yields	940
Domestic demand	940
Production and consumption, by States	940
Methods of distribution	942
Stocks	943
Prices	946
Exports	947
Kerosine and range oil	947
Distillate fuel oil	953
Residual fuel oil	964
Lubricating oil	973
Other products	974
Intercoastal shipments	977
Foreign trade	978
World production	986

GENERAL SUMMARY

THE outstanding feature of 1946 was the maintenance of total oil demand at a much higher level than had been expected. The shift from peak wartime operations to a full year of unrestricted civilian consumption was made with a decline of less than 1 percent in total demand—involving a sharp drop in exports that more than offset a small gain in domestic demand. Since domestic demand, as computed, includes all new domestic deliveries to our armed forces, the increase in 1946 indicated that the expansion in civilian requirements was more than adequate to offset the large decline in military takings. New records were set for domestic production and refinery operations, although the gains were relatively small. Appraisal of the trends shown in 1946 indicates that further large increases in demand may be expected in 1947 and that all existing facilities may be taxed to meet requirements.

The years 1941 and 1946 represent periods in which civilian consumption was supplied without restriction. In the intervening 4 years demand was distorted by war necessities. A comparison of 1946 with 1941 indicates an increase in daily crude-oil production from 3,842,000 barrels to 4,749,000—a gain of 907,000 barrels daily or almost 24 percent; daily crude runs to stills increased from 3,861,000 barrels to 4,740,000—a gain of almost 23 percent; daily total demand

[1] Data for 1946 are preliminary.

for all oils rose from 4,369,000 barrels to 5,321,000—an increase of almost 22 percent; and daily domestic demand increased from 4,071,000 barrels to 4,907,000—a gain of about 21 percent. These figures indicate that for the 5-year period the increase in normal demand had continued to approximate the prewar trends.

Among the principal factors of significance in 1946 were the upward trends in production and imports; the rebuilding of depleted stocks of refined products required by the shift from military to civilian demand; the tremendous drop in aviation-gasoline production, accentuated by negligible new military purchases due to liquidation of stocks in military custody; the rapid expansion in new heating-oil installations; and indication of the necessity for the prompt expansion of production, refining, and transportation facilities to meet a demand that promises to exceed all previous records.

Demand for all oils in the United States, 1937–46

[Millions of barrels]

Year	Domestic demand	Exports	Total demand	Year	Domestic demand	Exports	Total demand
1937	1,169.7	172.8	1,342.5	1942	1,449.9	116.9	1,566.8
1938	1,137.1	193.7	1,330.8	1943	1,521.4	150.0	1,671.4
1939	1,231.1	188.9	1,420.0	1944	1,671.3	207.6	1,878.9
1940	1,326.6	130.5	1,457.1	1945	1,772.7	183.0	1,955.7
1941	1,485.8	108.8	1,594.6	1946 [1]	1,791.0	151.2	1,942.2

[1] Subject to revision.

The new supply of all oils, including domestic production and imports, set a new daily record of 5,440,000 barrels in 1946—a gain of 119,000 barrels daily or 2.2 percent compared with 1945. Of this total, 119,000 barrels daily represented additions to stocks and left 5,321,000 barrels daily to supply the total demand for all oils. Total demand included exports and shipments of 419,000 barrels daily and a domestic demand in continental United States of 4,907,000 barrels daily. Compared with 1945, exports declined by 87,000 barrels daily and domestic demand increased 50,000 barrels daily.

The daily domestic production of all oils increased 1.2 percent in 1946 and averaged 5,070,000 barrels, including 4,749,000 barrels of crude petroleum and 321,000 of other oils. New records were established for both these sources. The record production, in spite of a small decline in total demand for all oils, was essential to rebuild depleted stocks during the year. The total production of all oils exceeded that of 1941 by 997,000 barrels daily or 24.5 percent.

Imports of all oils increased from 311,000 barrels daily in 1945 to 370,000 in 1946—a gain of 19 percent. Of the total increase of 59,000 barrels daily, crude petroleum showed a gain of 32,000 and refined products of 27,000. The total imports of crude oil in 1946 amounted to 86,066,000 barrels and included 115,000 barrels from the Persian Gulf imported in August. This initial shipment was for experimental purposes and may indicate a future trend to draw upon the immense reserves that have been developed in that area. Residual fuel oil represented 86 percent of the refined products imported and was primarily withdrawn from bond, free of duty, for use in bunkering ships engaged in foreign trade.

The total demand for all oils in 1946 amounted to 1,942.2 million barrels—a decline of 13.5 million barrels or less than 1 percent compared with the previous record year 1945. Compared with 1941, however, total demand gained almost 348 million barrels or about 22 percent. Compared with 1945, the relative changes, by products, were a 0.5-percent decline in total motor-fuel demand, a 9.9-percent decrease for residual fuel oil, a 4.9-percent gain for distillate fuel oil, and a 19.6-percent increase in total kerosine demand. The decline in total demand and the variation in changes, by products, reflected the sharp drop in exports as well as the shifts from military to civilian requirements.

Exports, including territorial shipments, declined from 183.0 million barrels in 1945 to 151.2 million in 1946. While crude-oil exports increased from 33.0 million barrels to 40.7 million, the export of refined products declined from 150.0 million barrels to 110.5 million. The most important change was the decline in motor-fuel exports from 88.1 million barrels in 1945 to 45.4 million in 1946. These figures include a decline in exports of aviation gasoline from 34.1 million barrels in 1945 to 2.3 million in 1946.

Salient statistics of crude petroleum, refined products, and natural gasoline in the United States, 1942–46

	1942	1943	1944	1945	1946 [1]
Crude petroleum:					
Domestic production—thousands of barrels [2]	1,386,645	1,505,613	1,677,904	1,713,655	1,733,424
World production—do	2,093,083	2,256,652	2,590,954	2,594,407	2,750,190
United States proportion of world production—percent	66	67	65	66	63
Imports [3]—thousands of barrels [2]	12,297	13,833	44,805	74,337	86,066
Exports [3]—do	33,834	41,342	34,238	32,998	40,750
Stocks, end of year:					
Gasoline-bearing crude—do	234,889	[4] 242,132	[4] 220,663	218,763	224,473
California heavy crude—do	10,865	[4] 7,272	6,107	4,496	5,703
Runs to stills—do	1,334,103	1,429,738	1,665,684	1,719,534	1,730,197
Total value of domestic production at wells—thousands of dollars	1,643,470	1,809,020	2,032,960	2,094,250	[5] 2,441,810
Average price per barrel at wells	$1.19	$1.20	$1.21	$1.22	$1.41
Total producing oil wells in the United States, Dec. 31	404,840	407,170	412,220	415,750	([6])
Total oil wells completed in the United States during year	10,524	9,717	13,029	14,297	15,851
Refined products:					
Imports [7]—thousands of barrels [2]	23,669	49,579	47,506	39,282	48,967
Exports [7]—do	83,073	108,615	173,378	149,985	110,454
Stocks, end of year—do	247,554	229,362	245,868	235,998	271,937
Output of motor fuel—do	608,900	608,180	739,340	798,194	776,054
Yield of gasoline—percent	39.8	37.1	39.4	40.9	39.6
Completed refineries, end of year	471	452	413	393	399
Daily crude oil capacity of refineries—thousands of barrels [2]	4,902	5,093	5,301	5,316	5,569
Average dealers' net price (excluding tax) of gasoline in 50 United States cities—cents per gallon [8]	10.44	10.45	10.49	10.33	10.40
Natural gasoline:					
Production—thousands of barrels [2]	83,322	87,716	100,046	112,004	115,153
Stocks, end of year—do	4,632	4,541	[4] 4,451	4,322	4,981

[1] Subject to revision.
[2] 42 gallons to the barrel.
[3] As reported to Bureau of Mines.
[4] Figure on a new basis and comparable with those of succeeding years. Figures on the old basis and comparable with preceding years are as follows: Gasoline-bearing crude, 243,506 in 1943 and 220,862 in 1944; California heavy crude, 8,289 in 1943; and natural gasoline, 4,252 in 1944.
[5] Estimated.
[6] Figure not available.
[7] U. S. Department of Commerce; exports include shipments to noncontiguous Territories.
[8] American Petroleum Institute.

Supply and demand of all oils in the United States in 1945–46, by months, in thousands of barrels

[Including wax, coke, asphalt, and still gas]

	1945 [1]													1944
	January	February	March	April	May	June	July	August	September	October	November	December	Total	
New supply:														
Domestic production:														
Crude petroleum	147,446	133,463	148,935	144,219	151,180	145,783	151,803	151,198	132,690	132,800	135,511	138,627	1,713,655	1,677,904
Natural gasoline	9,664	8,813	9,584	9,319	9,768	9,341	9,578	9,472	8,390	9,088	9,295	9,692	112,004	100,046
Benzol	240	240	240	240	240	240	240	240	240	240	240	240	2,880	2,400
Total production	157,350	142,516	158,759	153,778	161,188	155,364	161,621	160,910	141,320	142,128	145,046	148,559	1,828,539	1,780,350
Imports:														
Crude petroleum [2]	3,969	3,939	6,197	5,151	6,621	5,620	7,601	7,230	5,759	7,347	7,395	7,508	74,337	44,805
Refined products [3]	2,966	2,669	4,621	4,220	3,843	4,055	2,392	2,409	1,687	2,941	4,350	3,129	39,282	47,506
Total new supply	164,285	149,124	169,577	163,149	171,652	165,039	171,614	170,549	148,766	152,416	156,791	159,196	1,942,158	1,872,661
Change in stocks	−10,541	−7,481	−1,578	−2,619	−3,219	−2,477	+3,985	+7,182	−457	+2,989	+4,255	−3,549	−13,510	−6,218
Demand:														
Total demand	174,826	156,605	171,155	165,768	174,871	167,516	167,629	163,367	149,223	149,427	152,536	162,745	1,955,668	1,878,879
Exports:														
Crude petroleum [2]	1,302	1,599	1,973	2,663	3,208	2,915	3,533	3,308	3,166	3,603	3,399	2,329	32,998	34,238
Refined products [3]	14,230	10,905	17,625	18,247	18,871	17,509	12,995	7,258	8,293	6,991	7,691	9,370	149,985	173,378
Domestic demand:														
Motor fuel	52,008	48,856	55,364	59,024	60,748	60,580	66,170	70,058	64,529	55,708	53,543	49,745	696,333	632,482
Kerosine	8,831	7,587	6,805	4,521	5,467	4,741	4,394	3,803	5,253	6,788	7,597	9,786	75,573	71,812
Distillate fuel oil	25,063	23,451	19,781	15,916	18,357	14,723	15,370	15,108	14,234	16,432	19,078	28,571	226,084	209,320
Residual fuel oil	51,849	45,025	48,066	43,408	45,099	43,181	41,498	40,405	35,421	40,818	42,873	45,780	523,423	512,020
Lubricating oil	3,085	2,792	3,253	3,270	3,374	3,130	3,266	3,121	2,328	2,577	2,532	2,606	35,334	32,363
Miscellaneous	18,458	16,390	18,288	18,719	19,747	20,737	20,403	20,306	15,999	16,510	15,823	14,558	215,938	213,266
Total domestic demand	159,294	144,101	151,557	144,858	152,792	147,092	151,101	152,801	137,764	138,833	141,446	151,046	1,772,685	1,671,263
Stocks:														
Gasoline-bearing crude	221,737	220,221	223,988	224,229	223,151	218,218	216,638	215,135	220,319	221,246	218,916	218,763	218,763	220,663
Heavy crude petroleum in California	6,026	5,791	5,567	5,415	5,063	5,044	4,793	4,821	4,437	4,606	4,610	4,496	4,496	6,107
Natural gasoline	4,160	4,618	4,644	4,783	4,873	4,723	4,338	4,048	3,985	3,959	4,325	4,322	4,322	4,451
Refined products	234,625	228,437	223,290	220,443	218,564	221,189	227,390	236,337	231,143	233,062	239,277	235,998	235,998	245,868
Total stocks	466,548	459,067	457,489	454,870	451,651	449,174	453,159	460,341	459,884	462,873	467,128	463,579	463,579	477,089

See footnotes **at end of table.**

Supply and demand of all oils in the United States in 1945–46, by months, in thousands of barrels—Continued

[Including wax, coke, asphalt, and still gas]

	1946 [4]													1945
	January	February	March	April	May	June	July	August	September	October	November	December	Total	
New supply:														
Domestic production:														
Crude petroleum	143,368	132,129	136,835	140,196	148,334	146,890	152,586	149,910	143,708	148,323	144,674	146,471	1,733,424	1,713,655
Natural gasoline	9,882	9,011	9,323	9,073	9,379	9,351	9,408	9,671	9,424	10,125	10,005	10,501	115,153	112,004
Benzol	240	240	240	150	150	150	150	150	150	150	150	150	2,070	2,880
Total production	153,490	141,380	146,398	149,419	157,863	156,391	162,144	159,731	153,282	158,598	154,829	157,122	1,850,647	1,828,539
Imports:														
Crude petroleum [2]	6,917	6,787	6,812	7,466	7,508	6,880	6,978	8,296	7,508	7,001	6,852	7,061	86,066	74,337
Refined products [3]	4,510	3,911	3,353	2,299	4,667	4,238	4,067	4,218	4,494	3,731	4,215	5,264	48,967	39,282
Total new supply	164,917	152,078	156,563	159,184	170,038	167,509	173,189	172,245	165,284	169,330	165,896	169,447	1,985,680	1,942,158
Change in stocks	−2,336	+3,186	−285	+2,433	+4,439	+8,939	+10,816	+10,796	+13,976	+6,378	+1,121	−15,948	+43,515	−13,510
Demand:														
Total demand	167,253	148,892	156,848	156,751	165,599	158,570	162,373	161,449	151,308	162,952	164,775	185,395	1,942,165	1,955,668
Exports:														
Crude petroleum [2]	1,932	1,997	2,720	3,618	3,614	3,323	4,290	4,368	4,152	4,244	3,325	3,167	40,750	32,998
Refined products [3]	10,671	8,832	10,334	9,866	10,312	11,110	8,890	10,142	8,868	5,875	6,641	8,913	110,454	149,985
Domestic demand:														
Motor fuel	51,186	47,889	56,801	62,045	66,774	63,221	69,044	66,701	62,216	66,598	61,315	61,043	734,833	696,333
Kerosine	11,176	9,608	8,006	5,995	6,338	5,185	5,339	4,321	5,284	7,502	8,899	11,513	89,166	75,573
Distillate fuel oil	29,473	25,341	19,804	18,063	18,297	14,850	15,098	13,828	14,520	18,131	23,110	32,450	242,965	226,084
Residual fuel oil	44,966	39,332	42,229	37,911	39,346	39,283	36,734	37,925	33,509	37,014	41,497	47,405	477,151	523,423
Lubricating oil	2,689	2,275	2,562	3,061	2,866	2,715	3,049	3,236	3,095	3,536	2,900	2,900	34,884	35,334
Miscellaneous	15,160	13,618	14,392	16,192	18,052	18,883	19,929	20,928	19,664	20,052	17,088	18,004	211,962	215,938
Total domestic demand	154,650	138,063	143,794	143,267	151,673	144,137	149,193	146,939	138,288	152,833	154,809	173,315	1,790,961	1,772,685
Stocks:														
Gasoline-bearing crude	223,442	227,220	221,400	222,480	221,592	223,140	224,351	224,157	222,417	222,177	226,453	224,473	224,473	218,763
Heavy crude petroleum in California	4,554	4,607	4,528	4,533	4,913	4,921	4,968	5,066	5,401	5,483	5,335	5,703	5,703	4,496
Natural gasoline	5,034	5,843	6,658	6,982	7,004	7,343	7,334	6,943	7,060	6,312	5,487	4,981	4,981	4,322
Refined products	228,213	226,759	231,558	232,582	237,507	244,551	254,118	265,401	280,665	287,949	285,767	271,937	271,937	235,998
Total stocks	461,243	464,429	464,144	466,577	471,016	479,955	490,771	501,567	515,543	521,921	523,042	507,094	507,094	463,579

[1] Final figures. [2] As reported to Bureau of Mines. [3] U. S. Department of Commerce. [4] Subject to revision.

The domestic demand for all oils in continental United States increased from 1,772.7 million barrels in 1945 to 1,791.0 million in 1946—a gain of 1 percent. This net gain was a balance between the sharp drop in new military purchases and the rapid expansion in civilian requirements. The changes in the domestic demand for the major products in 1946, compared with 1945, indicated a 5.5-percent gain for motor fuel, an 8.8-percent decline for residual fuel oil, a 7.5-percent increase for distillate fuel oil, and an 18.0-percent gain for kerosine.

The total domestic demand for motor fuel rose from 696.3 million barrels in 1945 to 734.8 million in 1946. The outstanding factors in the domestic demand for motor fuel were the decline in aviation-gasoline demand from 117.0 million barrels in 1945 to 12.9 million in 1946; and the increase in the highway use of gasoline, according to the Public Roads Administration, from 455.9 million barrels in 1945 to 610.7 million in 1946. The new military purchases of aviation gasoline in 1946 amounted to only about 1 million barrels, due chiefly to the heavy reduction in accumulated stocks in military custody.

Domestic demand for residual fuel oil declined from 523.4 million barrels in 1945 to 477.2 million in 1946—an 8.8-percent drop. The main factors in this decline were the sharp drop in naval requirements and reductions in railroad and vessel use from the war peaks. Consumption by gas and electric companies increased substantially as reconversions were made from coal back to oil after the war shortage of oil passed.

Domestic demand for distillate fuel oil rose from 226.1 million barrels in 1945 to 243.0 million in 1946—a 7.5-percent increase. With a probable decline of 15 to 20 million barrels in new military purchases in 1946, the increased available domestic supply provided for a gain of possibly 18 percent in heating-oil requirements and substantial increases in railroad and industrial uses. The necessity for a rapid expansion in new housing facilities should cause a very rapid gain in the demand for heating oils in the next few years.

The domestic demand for kerosine increased from 75.6 million barrels in 1945 to 89.2 million in 1946—an 18.0-percent gain. The rapid expansion in the demand for kerosine is due to its use as range oil and for small space-heating units. Continued rapid increase in use for these purposes may be expected.

The rise in domestic demand for miscellaneous oil products has been very rapid—from 12.5 million barrels in 1941 to 37.9 million in 1945 and 46.0 million in 1946. The major products in this group are liquefied gases used for fuel and for chemical and rubber production. In 1946, the domestic demand for liquefied gases totaled 39.7 million barrels or 86 percent of the miscellaneous group. If the present rate of increase continues, liquefied gases will soon rank next to kerosine in importance among the marketed products of the industry.

Comparison of quarterly trends of supply and demand in 1946 with 1945 is difficult because of the transition from war requirements to civilian demand and the lack of comparative data for appraising the changes involved.

Crude runs to stills rose from 4,609,000 barrels daily in the first quarter to 4,765,000 in the second quarter and 4,851,000 in the third quarter and dropped to 4,734,000 barrels daily in the fourth quarter.

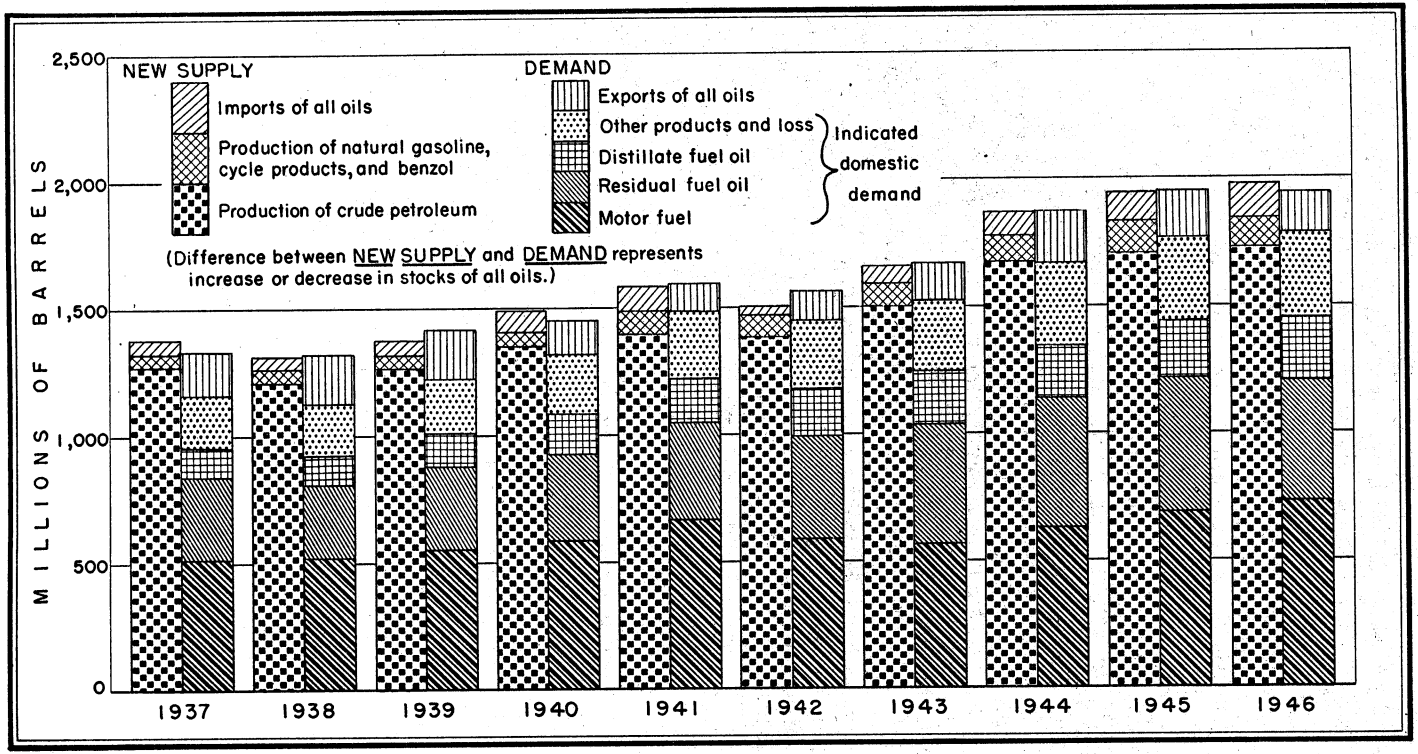

FIGURE 1.—Supply and demand of all oils in the United States, 1937-46.

The peak in the third quarter was due to a major increase in refined stocks amounting to 36.1 million barrels or 393,000 barrels daily. At the time, this large increase in stocks seemed more than ample, and consequently runs declined in the fourth quarter with the expectation that they might remain at a low level in the first quarter of 1947. However, demand expanded so rapidly in the last quarter of 1946 and in the first quarter of 1947 that the seasonal increase in stocks proved hardly adequate to meet requirements.

Domestic demand for all oils averaged 4,850,000 barrels daily in the first quarter of 1946, declined to 4,825,000 in the second and 4,722,000 in the third quarter, rose to 5,228,000 in the fourth quarter, and increased to 5,496,000 barrels in the first quarter of 1947. Domestic demand in the third quarter of 1946 was 1.7 percent less than in the same period of 1945 and 11.5 percent greater in the fourth quarter of 1946 than in the same period of 1945. The demand in the first quarter of 1947 exceeded that in the first quarter of 1946 by 13.3 percent.

The large relative gains in domestic demand in the last quarter of 1946 and the first quarter of 1947 set a new trend and resulted in sharp upward revisions in the forecasts for the succeeding quarters of 1947.

RESERVES

The Committee on Petroleum Reserves, American Petroleum Institute, estimated proved reserves of crude oil in the United States on December 31, 1946, at 20,874 million barrels compared with 19,942 million on December 31, 1945. Starting with 1945 the estimates have been revised to exclude condensate and to include crude petroleum only. These reserves include crude oil in known and proved fields recoverable under existing economic and operating conditions.

The increase in total reserves during 1946 was 932 million barrels. The largest gains in reserves were 812 million barrels for Texas, 93 million for Louisiana, 40 million for Colorado, 32 million for New Mexico, and 13 million for Mississippi. The greatest declines in reserves were 24 million barrels for California, 21 million for Arkansas, 12 million for Pennsylvania, and 11 million for Wyoming.

WORLD OIL SUPPLY

World production of crude petroleum again exceeded all previous records in 1946, increasing from 2,594 million barrels in 1945 to 2,750 million in 1946—a 6-percent gain. The total increase—156 million barrels—represented gains of 20 million in the United States (1 percent), 15 million in the U. S. S. R. (10 percent), and 61 million barrels in the Persian Gulf area (39 percent).

Comparing 1946 with 1941, the increase in the world production of crude petroleum amounted to 529 million barrels or almost 24 percent. Of this increase, 331 million barrels are credited to the United States and 198 million barrels to all other countries. The outstanding gains have been 160 million barrels in Venezuela, 158 million in the Persian

Estimates of proved oil reserves in the United States on December 31, 1940–46, by States [1]

[Millions of barrels]

State	1940	1941	1942	1943	1944	1945	1945 [2]	1946
Eastern States:								
Illinois	315	334	307	295	321	350	350	351
Indiana	14	23	32	31	31	41	41	44
Kentucky	41	36	35	35	41	57	57	59
Michigan	35	56	64	55	65	64	64	69
New York	65	60	54	90	86	81	81	76
Ohio	30	37	35	33	32	30	30	29
Pennsylvania	188	171	153	137	123	110	110	98
West Virginia	53	50	47	44	41	39	39	36
	741	767	727	720	740	772	772	762
Central and Southern States:								
Arkansas	306	295	300	297	293	304	288	267
Kansas	692	690	687	646	602	542	542	545
Louisiana	1,216	1,330	1,442	1,484	1,573	1,690	1,559	1,652
Mississippi	40	80	41	39	209	267	257	270
New Mexico	692	675	677	654	563	512	512	544
Oklahoma	1,002	1,036	969	909	970	890	889	898
Texas	10,624	10,976	11,546	11,325	11,375	11,470	10,835	11,647
	14,572	15,082	15,662	15,354	15,585	15,675	14,882	15,823
Mountain States:								
Colorado	23	23	39	45	89	260	260	300
Montana	89	86	86	108	112	108	108	104
Wyoming	305	304	371	499	582	600	600	589
	417	413	496	652	783	968	968	993
Pacific Coast States: California	3,291	3,323	3,196	3,337	3,344	3,410	3,318	3,294
Other States	4	4	2	1	1	2	2	2
Total United States	19,025	19,589	20,083	20,064	20,453	20,827	19,942	20,874

[1] From reports of Committee on Petroleum Reserves, American Petroleum Institute, of the amount of crude oil that may be extracted by present methods from fields completely developed or sufficiently explored to permit reasonably accurate calculations. The change in reserves during any year represents total new discoveries, extensions, and revisions, minus production.

[2] New basis; excludes condensate.

Gulf area, and 23 million barrels in Iraq. The principal declines were 74 million barrels in Russia, 52 million in the Netherlands Indies, and 9 million barrels in Rumania.

According to Bureau of Mines data for 1946, total oil exports from continental United States amounted to 151 million barrels compared with imports of 135 million, so that the net export was only 16 million barrels compared with a net export of 12 million in 1941. These figures indicate that the United States has reached a point where domestic demand approximates production.

The domestic demand for all oils in continental United States has increased from 1,486 million barrels in 1941 to 1,791 million in 1946—a gain of 305 million barrels or almost 21 percent. Considering the small net export from the United States, the supply of oil for the rest of the world closely approximates foreign crude production, which rose from 819 million barrels in 1941 to 1,017 million in 1946—a gain of 24 percent. Considering the material decrease in the foreign production of liquid fuels from coal and other sources since 1941, the total demand for all oils outside the United States probably has increased at a rate approximating that in the United States.

CRUDE PETROLEUM

SUPPLY AND DEMAND

The total demand for crude petroleum in the United States increased to the record level of 1,813 million barrels in 1946—a gain of 21 million barrels or over 1 percent compared with 1945. The demand for domestic crude petroleum rose from 1,718 million barrels in 1945 to 1,728 million in 1946—a gain of 10 million barrels. The demand for imported crude oil amounted to 85 million barrels in 1946—a gain of 11 million compared with 1945.

Compared with 1945, the production of domestic crude petroleum in 1946 increased 20 million barrels, imports of crude oil were 12 million barrels greater, and total stocks of crude oil gained 7 million barrels compared with a decrease of almost 4 million barrels for the previous year.

The principal changes in crude-oil demand were an increase of 11 million barrels in total runs to stills, a gain of 8 million barrels in crude exports, and an increase of over 2 million barrels in transfers of crude oil to fuel oils.

Supply of and demand for crude petroleum in the United States, 1942–46

[Thousands of barrels]

	1942	1943	1944	1945	1946 [1]
Production	1,386,645	1,505,613	1,677,904	1,713,655	1,733,424
Imports [2]	12,297	13,833	44,805	74,337	86,066
Changes in stocks [3]	−11,924	+6,041	−22,435	−3,511	+6,917
Total supply	1,410,866	1,513,405	1,745,144	1,791,503	1,812,573
Runs to stills:					
Domestic	1,319,507	1,417,559	1,622,514	1,645,862	1,645,845
Foreign	14,596	12,179	43,170	73,672	84,352
Exports [2]	33,834	41,342	34,238	32,998	40,750
Transfers to fuel oil:					
Distillate	2,484	3,070	3,242	3,047	3,123
Residual	19,295	24,087	28,515	20,727	23,142
Other fuel and losses	21,150	15,168	13,465	15,197	15,361
Total demand	1,410,866	1,513,405	1,745,144	1,791,503	1,812,573

[1] Subject to revision.
[2] As reported to Bureau of Mines.
[3] Inclusive of heavy crude in California.

PRODUCTION

General.—Production of crude petroleum in the United States set a new record of 1,733,424,000 barrels in 1946—a gain of 20 million barrels compared with 1945. Production in 1946 was 331 million barrels or 24 percent greater than in 1941. This expansion in production since 1941 has taken place with only a small increase in proved reserves. The volume of shut-in production has been so reduced that an expanded program of exploration and drilling will be essential if the increasing demand for crude oil is to be met from domestic production.

The principal gains in production in 1946 compared with 1945 were 12 million barrels for Louisiana, 7 million for Colorado, 6 million for Texas, and 5 million for Mississippi. The largest declines were 11 million barrels for California and 5 million for Oklahoma.

Six States produced 88 percent of the crude petroleum output in 1946. Texas ranked first with 43.9 percent of the total and California was second with 18.2 percent. Louisiana was third with 8.3 percent, Oklahoma fourth with 7.8 percent, Kansas fifth with 5.6 percent, and Illinois sixth with 4.3 percent.

The East Texas field has been the largest producer in the United States and had an output of 120.6 million barrels in 1946—a decline of almost 11 million compared with 1945. In California, production in the Wilmington field increased 4 million barrels to a total of 40.2 million barrels in 1946, while production in the Coalinga field declined over 2 million barrels to 29.2 million in 1946. The West Edmond field in Oklahoma ranked fourth in 1946 with a production of 23.6 million barrels—a decline of 3 million compared with 1945.

Petroleum produced in the United States, 1942–46, and total, 1859–1946, by States [1]

[Thousands of barrels]

	1942	1943	1944	1945	1946 [2]	1859–1946 (total)
Production:						
Alabama			43	181	380	604
Arkansas	26,628	27,600	29,418	28,613	28,375	673,378
California	248,326	284,188	311,793	326,482	315,179	7,286,309
Colorado	2,199	2,320	3,083	5,036	12,016	66,700
Illinois	106,391	82,260	77,413	75,094	75,297	1,248,520
Indiana	6,743	5,283	5,118	4,868	6,726	167,259
Kansas	97,636	106,178	98,762	96,415	97,218	[3] 1,700,384
Kentucky	4,534	7,883	9,621	10,325	10,578	[4] 214,864
Louisiana	115,785	123,592	129,645	131,051	143,303	1,819,273
Michigan	21,754	20,768	18,490	17,267	17,074	[5] 256,818
Mississippi	28,833	18,807	16,337	19,062	24,216	127,089
Montana	8,074	7,916	8,647	8,420	8,801	132,876
Nebraska	1,237	635	417	305	265	5,035
New Mexico	31,544	38,896	39,555	37,351	36,860	[6] 498,534
New York	5,421	5,059	4,697	4,648	4,863	[7] 148,650
Ohio	3,543	3,322	2,937	2,828	2,908	607,425
Oklahoma	140,690	123,152	124,616	139,299	134,497	[3] 5,623,079
Pennsylvania	17,779	15,757	14,118	12,515	12,996	[7] 1,086,983
Texas	483,097	594,343	746,699	754,710	760,505	10,424,733
West Virginia	3,574	3,349	3,070	2,879	2,929	430,004
Wyoming	32,812	34,253	33,356	36,219	38,304	705,800
Other States [8]	45	52	69	87	134	1,570
Total	1,386,645	1,505,613	1,677,904	1,713,655	1,733,424	33,225,887
Value at wells:						
Total (thousands of dollars)	1,643,470	1,809,020	2,032,960	2,094,250	2,441,810	39,766,889
Average per barrel	$1.19	$1.20	$1.21	$1.22	$1.41	$1.20

[1] For detailed figures by States, 1859–1935, see Minerals Yearbook, 1937, p. 1008.
[2] Subject to revision.
[3] Oklahoma included with Kansas in 1905 and 1906.
[4] Includes Tennessee, 1883–1907
[5] Figures represent 1925–46 production only; earlier years included with "Other States."
[6] Figures represent 1924–46 production only; earlier years included with "Other States."
[7] Early production in New York included with Pennsylvania.
[8] Includes Alaska, 1912–33; Arkansas, 1920; Michigan, 1900–19; Missouri, 1889–1911, 1913–16, 1919–23, 1932–46; New Mexico, 1913, 1919–23; Tennessee, 1916–46, Utah, 1907–11, 1920, 1924–41; Florida, 1943–46; Virginia 1943–46.

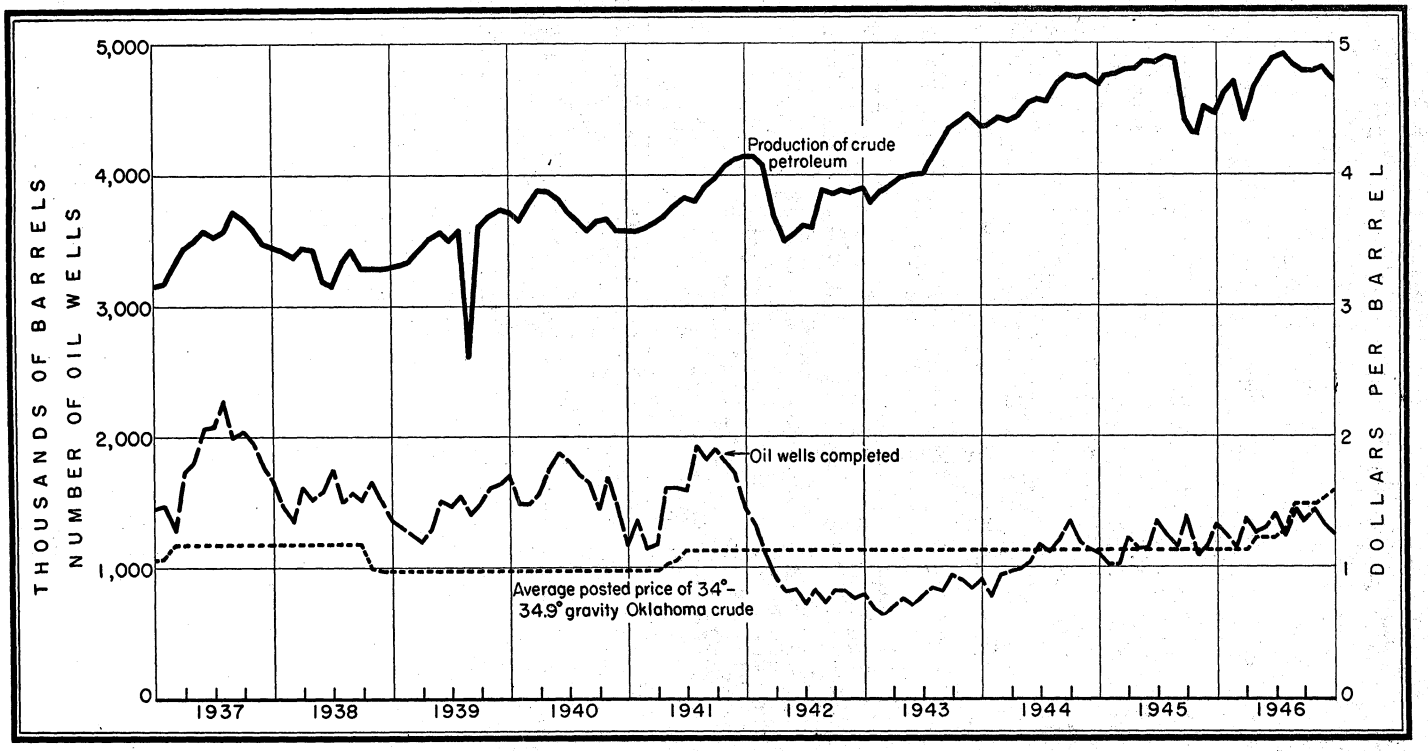

FIGURE 2.—Daily average production of crude petroleum, total number of wells completed, and average posted price per barrel of a selected grade of Oklahoma crude petroleum in the United States, 1937-46, by months.

Production of crude petroleum in the United States in 1945,[1] by districts, States, and months

[Thousands of barrels]

District and State	January	February	March	April	May	June	July	August	September	October	November	December	Total
DISTRICT													
Pennsylvania Grade	1,740	1,574	1,875	1,789	1,897	1,838	1,853	1,943	1,719	1,897	1,748	1,668	21,541
Other Appalachian [2]	991	878	775	932	1,013	964	995	1,003	909	999	1,068	979	11,506
Lima-Northeastern Indiana-Michigan	1,469	1,343	1,529	1,446	1,528	1,508	1,526	1,498	1,354	1,469	1,408	1,403	17,481
Illinois-Southwestern Indiana	6,792	6,260	6,747	6,508	6,911	6,627	6,829	6,892	6,132	6,815	6,679	6,746	79,938
Mid-Continent:													
North Louisiana, Arkansas, Alabama, and Mississippi	5,991	5,546	6,021	5,791	6,048	5,863	6,090	6,081	5,807	6,048	5,986	6,254	71,526
West Texas and Southeastern New Mexico	18,130	16,073	18,413	18,035	18,673	18,000	19,378	19,378	16,134	15,738	16,948	17,723	212,623
East Texas	11,913	10,982	11,846	11,399	11,870	11,393	11,773	11,796	9,688	9,570	9,525	9,449	131,204
Oklahoma, Kansas, North Texas, etc	36,587	32,827	37,130	35,585	37,300	35,960	37,454	37,860	34,130	34,887	35,485	35,669	430,874
Gulf Coast	32,069	29,079	32,323	31,062	32,312	31,119	32,149	31,793	26,908	25,640	27,323	28,573	360,350
Rocky Mountain	4,096	3,763	4,256	4,152	4,421	4,263	4,573	4,438	3,918	4,084	4,093	4,073	50,130
California [3]	27,668	25,138	28,020	27,520	29,207	28,248	29,183	28,516	25,991	25,653	25,248	26,090	326,482
Total 1945	147,446	133,463	148,935	144,219	151,180	145,783	151,803	151,198	132,690	132,800	135,511	138,627	1,713,655
STATE													
Alabama	6	10	11	14	15	23	25	22	6	7	18	24	181
Arkansas	2,512	2,244	2,475	2,392	2,493	2,377	2,459	2,396	2,276	2,336	2,276	2,377	28,613
California [3]	27,668	25,138	28,020	27,520	29,207	28,248	29,183	28,516	25,991	25,653	25,248	26,090	326,482
Colorado	300	270	292	316	379	352	376	371	421	615	688	656	5,036
Florida			1	5	1	4	6	4	4	3		2	30
Illinois	6,369	5,875	6,389	6,151	6,486	6,222	6,403	6,452	5,747	6,400	6,279	6,321	75,094
Indiana	425	387	360	359	427	407	428	442	387	417	402	427	4,868
Kansas	8,334	7,403	8,497	8,003	8,329	8,063	8,334	8,282	7,882	8,176	7,709	7,403	96,415
Kentucky	911	791	665	837	905	850	893	886	814	898	982	893	10,325
Louisiana	10,861	10,040	11,067	10,608	11,183	10,847	11,187	11,234	10,604	11,046	11,011	11,363	131,051
Michigan	1,462	1,327	1,509	1,428	1,506	1,486	1,505	1,480	1,336	1,449	1,391	1,388	17,267
Mississippi	1,514	1,451	1,582	1,564	1,590	1,553	1,625	1,690	1,556	1,633	1,632	1,672	19,062
Montana	729	639	715	692	738	710	719	735	691	705	664	683	8,420
Nebraska	25	28	21	31	28	26	26	26	22	27	19	26	305
New Mexico	3,236	2,930	3,250	3,139	3,241	3,081	3,252	3,205	3,064	3,021	2,970	2,962	37,351
New York	363	329	386	382	417	386	395	431	377	421	394	367	4,648
Ohio	195	208	258	233	251	246	248	265	229	258	223	214	2,828
Oklahoma	11,394	10,258	11,599	11,335	11,972	11,618	12,002	12,147	11,650	11,523	11,854	11,947	139,299
Pennsylvania	1,015	919	1,096	1,043	1,109	1,097	1,082	1,111	996	1,089	995	963	12,515
Texas	66,851	60,178	67,260	64,823	67,394	64,776	67,970	67,940	55,640	54,151	57,811	59,916	754,710
West Virginia	251	218	261	236	246	238	242	264	223	244	236	220	2,879
Wyoming	3,023	2,816	3,215	3,103	3,258	3,168	3,438	3,294	2,770	2,722	2,703	2,709	36,219
Other States	2	4	6	5	5	5	5	5	4	6	6	4	[4] 57
Total: 1945	147,446	133,463	148,935	144,219	151,180	145,783	151,803	151,198	132,690	132,800	135,511	138,627	1,713,655
1944	135,682	128,842	136,814	133,588	141,189	137,263	141,438	145,407	142,985	146,911	142,463	145,322	1,677,904
Daily average, 1945	4,756	4,767	4,804	4,807	4,877	4,859	4,897	4,877	4,423	4,284	4,517	4,472	4,695

[1] Final figures. [2] Includes Florida, Kentucky, Tennessee, and Virginia. [3] American Petroleum Institute. [4] Missouri (45), Tennessee (8), and Virginia (4).

Production of crude petroleum in the United States in 1946,[1] by districts, States, and months

[Thousands of barrels]

District and State	January	February	March	April	May	June	July	August	September	October	November	December	Total
DISTRICT													
Pennsylvania Grade	1,878	1,670	1,853	1,931	1,967	1,895	1,795	1,960	1,857	2,001	1,808	1,848	22,463
Other Appalachian [2]	958	920	1,022	1,003	1,042	997	1,017	999	957	966	898	931	11,710
Lima-Northeastern Indiana-Michigan	1,447	1,254	1,498	1,495	1,519	1,440	1,501	1,517	1,429	1,454	1,349	1,379	17,282
Illinois-Southwestern Indiana	6,874	6,384	7,040	6,835	7,190	6,775	7,029	6,803	6,757	7,128	6,523	6,661	81,999
Mid-Continent:													
North Louisiana, Arkansas, Alabama, and Mississippi	6,392	5,834	6,444	6,434	6,879	6,749	7,121	7,379	7,255	7,632	7,635	7,985	83,739
West Texas and Southeastern New Mexico	18,613	17,114	16,766	17,998	19,449	20,913	21,332	19,512	18,795	19,409	19,343	19,446	228,690
East Texas	9,902	8,996	9,960	11,204	12,092	9,873	9,926	9,870	9,782	9,843	9,843	9,789	121,080
Oklahoma, Kansas, North Texas, etc	36,957	33,823	34,721	35,185	37,007	36,296	38,156	38,013	36,054	37,296	36,140	36,410	436,058
Gulf Coast	29,874	28,177	26,335	27,300	29,313	30,810	32,221	31,704	29,769	30,519	30,069	29,546	355,637
Rocky Mountain	4,471	4,200	4,776	4,917	5,031	5,069	5,394	5,269	5,052	5,238	4,951	5,219	59,587
California [3]	26,002	23,757	26,420	25,894	26,845	26,073	27,094	26,884	26,001	26,837	26,115	27,257	315,179
Total 1946	143,368	132,129	136,835	140,196	148,334	146,890	152,586	149,910	143,708	148,323	144,674	146,471	1,733,424
STATE													
Alabama	27	28	34	33	36	34	35	33	29	32	30	29	380
Arkansas	2,381	2,153	2,352	2,317	2,418	2,323	2,418	2,407	2,337	2,434	2,377	2,458	28,375
California [3]	26,002	23,757	26,420	25,894	26,845	26,073	27,094	26,884	26,001	26,837	26,115	27,257	315,179
Colorado	733	686	812	847	940	1,027	1,162	1,188	1,123	1,177	1,138	1,183	12,016
Florida	4	3	3	5	7	8	6	4	6		2	9	57
Illinois	6,394	5,882	6,443	6,232	6,581	6,200	6,453	6,237	6,214	6,550	6,006	6,105	75,297
Indiana	482	504	599	605	611	577	578	568	545	580	519	558	6,726
Kansas	7,866	7,134	7,778	7,719	8,180	7,959	8,486	8,651	8,229	8,624	8,192	8,400	97,218
Kentucky	866	835	929	907	940	897	922	906	866	875	812	823	10,578
Louisiana	11,608	10,604	11,635	11,169	11,915	11,583	12,357	12,408	12,083	12,700	12,419	12,822	143,303
Michigan	1,430	1,238	1,482	1,474	1,501	1,423	1,483	1,498	1,412	1,435	1,335	1,363	17,074
Mississippi	1,697	1,554	1,663	1,707	1,918	1,921	1,981	2,220	2,187	2,362	2,407	2,599	24,216
Montana	732	667	744	776	788	766	775	758	728	731	637	699	8,801
Nebraska	25	21	22	25	27	24	25	23	20	20	18	15	265
New Mexico	3,046	2,743	3,063	3,006	3,127	3,001	3,129	3,176	3,057	3,219	3,101	3,192	36,860
New York	418	370	398	416	424	405	404	416	397	428	383	404	4,863
Ohio	234	214	242	248	260	245	238	243	242	260	235	247	2,908
Oklahoma	11,965	10,861	11,139	11,085	11,530	11,118	11,630	11,598	10,639	11,103	10,823	11,006	134,497
Pennsylvania	1,074	956	1,066	1,120	1,134	1,092	1,049	1,132	1,082	1,160	1,056	1,075	12,996
Texas	63,160	58,874	56,579	61,089	65,617	66,730	68,727	65,996	63,107	64,243	63,696	62,687	760,505
West Virginia	254	225	250	256	259	259	208	274	235	258	225	226	2,929
Wyoming	2,963	2,814	3,176	3,261	3,271	3,220	3,421	3,285	3,164	3,289	3,139	3,301	38,304
Other States	7	6	6	5	5	5	5	5	5	6	9	13	[4] 77
Total: 1946	143,368	132,129	136,835	140,196	148,334	146,890	152,586	149,910	143,708	148,323	144,674	146,471	1,733,424
1945	147,446	133,463	148,935	144,219	151,180	145,783	151,803	151,198	132,690	132,800	135,511	138,627	1,713,655
Daily average, 1946	4,625	4,719	4,414	4,673	4,785	4,896	4,922	4,836	4,790	4,785	4,822	4,725	4,749

[1] Subject to revision.
[2] Includes Florida, Kentucky, Tennessee, and Virginia.
[3] American Petroleum Institute.
[4] Missouri (51), Tennessee (10), and Virginia (16).

Percentage of total crude petroleum produced in the United States, 1937–46, by principal States

State	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946[1]
Texas	39.9	39.2	38.2	36.4	36.1	34.8	39.5	44.5	44.0	43.9
California	18.6	20.6	17.7	16.6	16.4	17.9	18.9	18.6	19.1	18.2
Louisiana	7.1	7.8	7.4	7.7	8.3	8.3	8.2	7.7	7.7	8.3
Oklahoma	17.9	14.4	12.7	11.5	11.0	10.2	8.2	7.4	8.1	7.8
Kansas	5.5	5.0	4.8	4.9	5.9	7.0	7.0	5.9	5.6	5.6
Illinois	.6	2.0	7.5	10.9	9.4	7.7	5.5	4.6	4.4	4.3
Wyoming	1.5	1.6	1.7	1.9	2.1	2.4	2.3	2.0	2.1	2.2
New Mexico	3.1	2.9	3.0	2.9	2.8	2.3	2.6	2.4	2.2	2.1
Arkansas	.9	1.5	1.7	1.9	1.9	1.9	1.8	1.8	1.7	1.6
Mississippi				.3	1.1	2.1	1.2	1.0	1.1	1.4
Michigan	1.3	1.5	1.8	1.5	1.2	1.6	1.4	1.1	1.0	1.0
Pennsylvania	1.5	1.4	1.4	1.3	1.2	1.3	1.0	.8	.7	.7
Colorado	.1	.1	.1	.1	.2	.1	.2	.2	.3	.7
All other	2.0	2.0	2.0	2.1	2.4	2.4	2.2	2.0	2.0	2.2
Total United States	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Subject to revision.

Production of crude petroleum in leading fields and districts in the United States, 1945–46, and total production since discovery, in thousands of barrels

[Oil and Gas Journal]

Field	State	1945	1946	Total since discovery (revised)
East Texas	Texas	131,210	120,581	2,357,467
Wilmington	California	36,222	40,244	321,722
Coalinga	do	31,549	29,198	533,512
West Edmond	Oklahoma	26,548	23,565	58,545
Wasson	Texas	23,256	21,299	123,342
Slaughter	do	23,440	20,858	93,165
Conroe	do	20,992	20,718	227,250
Hastings	do	20,608	19,355	125,999
Webster	do	19,820	18,708	83,814
Huntington Beach	California	17,558	17,144	378,732
Ventura Avenue	do	17,663	16,899	320,012
Keystone	Texas	6,535	15,754	36,458
Bradford-Allegany[1]	Pennsylvania-New York	15,036	15,602	542,801
Hawkins	Texas	12,210	14,786	61,688
Buena Vista Hills	California	15,759	14,762	330,135
Gray County	Texas	14,880	14,619	263,523
Kettleman North Dome	California	14,349	13,867	323,919
Yates	Texas	13,053	13,555	315,256
Midway-Sunset	California	14,373	13,469	703,807
Santa Maria Valley	do	13,538	11,944	74,978
Fullerton	Texas	6,478	10,930	21,377
Oklahoma City	Oklahoma	12,968	10,693	642,546
Van	Texas	10,494	10,690	172,903
Hutchinson County	do	10,872	10,389	212,493
Anahuac	do	10,923	10,127	65,766
North Cowden	do	9,997	10,098	57,584
McElroy	do	10,717	9,784	164,548
Thompson	do	12,749	9,361	80,281
Long Beach	California	9,803	9,107	721,526
Goldsmith	Texas	8,381	8,838	73,001
Talco	do	8,284	8,741	92,985
Louden	Illinois	9,463	8,243	129,480
Tinsley	Mississippi	9,345	8,090	94,271
Rangely	Colorado	1,495	8,018	11,533
K-M-A	Texas	8,309	7,861	111,015
Seminole	do	8,088	7,486	32,667
Coyote	California	7,097	7,330	203,231
West Ranch	Texas	7,127	7,079	40,260
Monument	New Mexico	7,139	6,565	80,409
Santa Fe Springs	California	6,258	6,113	508,933
Old Ocean	Texas	5,936	6,107	23,732
Eunice	New Mexico	5,707	6,007	92,279
Salem	Illinois	6,637	5,967	198,193
Elk Basin	Wyoming-Montana	4,111	5,838	28,549
Clay City	Illinois	5,104	5,309	45,999
Edison	California	2,141	5,305	18,948
Lance Creek	Wyoming	5,463	4,669	73,757
Salt Creek	do	4,499	4,658	322,379
Cut Bank	Montana	4,907	4,606	51,765

[1] Bureau of Mines.

BY STATES

Alabama.—Drilling declined sharply from 37 completions in 1945 to 16 in 1946 as development and exploration subsided. Three oil wells were completed in the Gilbertown area, and all of the 11 exploratory wells drilled were failures.

Production from Gilbertown, the only producing area was at stable rates during 1946, amounting to 380,000 barrels compared with 181,000 barrels in 1945.

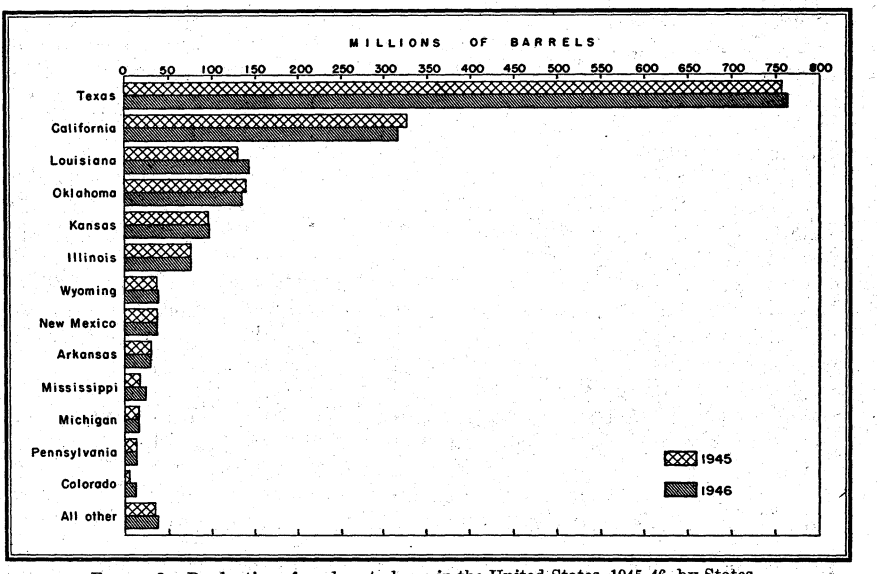

FIGURE 3.—Production of crude petroleum in the United States, 1945–46, by States.

Arkansas.—Production declined from 28,613,000 barrels in 1945 to 28,375,000 in 1946 but in the last quarter was above the rate of comparable 1945 months. Output of the Village and Atlanta fields gained materially to new highs, but elsewhere moderate declines were the rule.

Production of crude petroleum in Arkansas, 1942–46, by fields

[Thousands of barrels]

Year	Atlanta	Dorcheat-Macedonia	El Dorado	McKamie	Magnolia	Midway	Schuler	Smackover	Stephens	Urbana[1]	Village	Other fields[2]	Total
1942	1,034	1,012	497	723	6,364	1,218	5,913	4,907	614	985	423	2,938	26,628
1943	956	1,602	449	360	6,041	2,168	5,520	4,458	1,485	1,058	439	3,064	27,600
1944	1,164	2,345	416	1,107	5,592	2,382	5,105	4,280	1,828	1,019	568	3,612	29,418
1945	1,329	1,759	402	1,064	4,951	2,641	4,733	4,146	2,035	817	816	3,920	28,613
1946[3]	1,578	1,446	378	1,062	4,718	2,646	4,419	4,092	1,866	652	1,230	4,288	28,375

[1] Includes New London, 1943–46.
[2] Includes oil consumed on leases and net change in stocks held on leases for entire State.
[3] Subject to revision.

Oil-well completions numbered 110, of which 9 were exploratory. The most active field was Wesson, a 1945 discovery, with 38 oil wells added. Other leading fields with oil completions were: Stephens 17, Village 11, and Gum Creek 9.

Five oil fields were discovered: East McNeil in Columbia County, West Lewisville and Spirit Lake in Lafayette (Lower Glen Rose), Willesville (Nacatoch) in Nevada, and Pace City (Hosston) in Ouachita. Spirit Lake and West Lewisville are reported to be most promising. Several producing zones were opened at Wesson and others at Buckner, Village, West Lewisville, and Rainbow City.

California.—Crude production declined 11.3 million barrels in 1946 from the record total of 1945 to 315,179,000 barrels, exceeding 1946 demand, however, by almost 5 million barrels. To maintain this level of output the State's fields, except for the Elk Hills Naval Reserve, produced at a higher rate than in 1945.

In the San Joaquin Valley a decline of 11.7 million barrels resulted from the cut-back of 12.1 million barrels at Elk Hills and gains chiefly at Edison and Cymric that offset declines in most of the leading fields.

Output of the Coastal district declined 2 percent to 52,586,000 barrels as withdrawals from the leading fields, Ventura Avenue and Santa Maria Valley, were reduced from 1945 peaks. Capitan, Elwood, and Ventura-Newhall recorded increased production.

The Los Angeles Basin district increased its production 1.7 million barrels over 1945 to 113,194,000 barrels because of a 4-million-barrel gain at Wilmington, the State's leading field, to 40,224,000 barrels.

Oil-well completions declined from 1,690 in 1945 to 1,375 in 1946. The most active fields, with completions in each, were: Wilmington 183, Cymric 108, Belridge South 83, Edison 72, and Newport 70.

Production of crude petroleum in California, 1942–46, by districts and fields, in thousands of barrels

[American Petroleum Institute]

District and field	1942	1943	1944	1945	1946 [1]
San Joaquin Valley:					
Belridge	2,917	4,543	6,340	6,959	5,865
Canal	1,069	1,446	1,297	1,244	864
Coalinga	19,323	31,386	35,410	31,681	29,204
Coles Levee [2]	5,436	5,906	6,692	7,030	6,335
Edison	1,020	900	1,051	2,166	5,299
Elk Hills	4,363	5,373	7,719	15,805	3,667
Fruitvale	2,312	2,571	3,043	3,096	2,735
Greeley	2,583	4,819	5,219	5,062	3,892
Helm	81	166	499	1,211	1,583
Jacalitos	57	118	236	1,179	1,618
Kern River—Kern Front	5,707	7,274	8,440	8,210	8,166
Kettleman Hills	13,014	15,300	15,133	14,357	13,868
Lost Hills	1,398	1,328	1,284	1,228	1,319
McKittrick [3]	1,791	1,719	1,851	2,043	4,820
Midway-Sunset [4]	20,470	20,227	22,065	30,106	28,220
Mountain View	1,602	1,394	1,156	1,024	1,401
Mount Poso	7,566	8,432	8,025	6,717	5,960
Pleasant Valley		235	935	1,309	1,308
Raisin City	305	382	936	1,163	1,020
Rio Bravo	3,579	5,446	5,920	5,743	4,866
Riverdale	93	590	1,517	1,540	1,481
Round Mountain	3,917	4,150	3,932	3,507	3,356
Ten Section	4,805	6,558	4,624	4,095	3,229
Other San Joaquin Valley	1,667	2,776	4,170	4,656	9,323
Total San Joaquin Valley	105,075	133,039	147,494	161,131	149,399

See footnotes at end of table.

Production of crude petroleum in California, 1942–46, by districts and fields, in thousands of barrels—Continued

District and field	1942	1943	1944	1945	1946 [1]
Coastal district:					
Aliso Canyon	715	755	1,100	1,156	1,105
Capitan	844	1,178	1,079	794	1,266
Elwood	873	1,668	2,133	2,172	2,451
Gato Ridge	1,217	1,295	1,777	1,615	1,430
Rincon	1,010	1,210	1,501	1,689	1,628
San Martinez (Del Valle, West)	237	473	855	1,196	1,211
San Miguelito	1,238	1,614	2,111	1,940	1,843
Santa Maria	2,726	3,791	4,892	5,038	4,931
Santa Maria Valley	7,550	8,303	11,358	13,489	11,931
Ventura Avenue	13,644	15,461	17,504	17,701	16,914
Ventura-Newhall	3,041	3,639	4,133	4,281	4,688
Other Coastal	853	1,134	1,560	2,768	3,188
Total Coastal	33,948	40,521	50,003	53,839	52,586
Los Angeles Basin:					
Brea Olinda	3,716	4,252	4,304	4,195	3,945
Coyote	5,848	6,502	6,434	7,105	7,330
Dominguez	7,932	9,118	7,879	6,726	5,867
Huntington Beach	12,096	13,239	17,162	17,587	17,133
Inglewood	6,750	6,913	6,467	5,624	4,720
Long Beach	13,131	11,641	10,862	9,851	9,104
Montebello	3,961	3,966	3,932	3,665	3,133
Richfield	2,890	2,689	2,564	2,741	2,713
Rosecrans	2,722	2,215	2,238	2,095	1,851
Santa Fe Springs	7,761	7,307	6,838	6,278	6,114
Seal Beach	3,027	2,867	2,835	3,426	3,695
Torrance	3,049	2,874	3,186	3,241	3,144
Wilmington	33,657	34,349	36,929	36,192	40,224
Other Los Angeles Basin	2,763	2,696	2,666	2,786	4,221
Total Los Angeles Basin	109,303	110,628	114,296	111,512	113,194
Total California	248,326	284,188	311,793	326,482	315,179

[1] Subject to revision.
[2] Includes Tupman.
[3] Includes Cymric.
[4] Includes Buena Vista Hills.

Completion of 260 wildcat wells resulted in 14 oil-field discoveries, a number of new pools or extensions to older fields. As in 1945, Kern County was prospected most intensively, having 113 exploratory completions compared with the next most active counties—Los Angeles with 34, Orange with 22, and Ventura with 16. However, 9 of the new oil fields were in Los Angeles County and 5 in Kern. Early indications were that the Salt Creek field in Kern County and the East Los Angeles field may be the most significant of the discoveries. The principal new pool discoveries were at Cymric, Elk Hills, Newhall-Potrero, Ramona, Newport, and Potrero. Important extensions were reported at South Belridge, Elk Hills, Midway-Sunset and Wilmington.

According to estimates of the American Petroleum Institute, reserves of crude petroleum added in 1946 were slightly less than crude production.

Colorado.—Production of 12,016,000 barrels of crude petroleum in 1946 compared with 5,036,000 barrels in 1945 reflected expansion of the great Rangely field, whose output increased from 1,565,000 barrels to 8,314,000. Wilson Creek, second in importance to Rangely, increased its output 328,000 barrels to 2,381,000 in 1946. Changes in other fields were small. Further marked expansion in Rangely production is indicated by field conditions and by plans for a second pipe-line outlet running westward to Salt Lake City.

Oil-well completions in 1946 advanced to a record total of 148, of which 141 were at Rangely, 4 at Wilson Creek, and 3 elsewhere. Twenty-one exploratory wells were drilled, discovering 1 oil field and effecting 3 extensions to the Rangely field. The new oil field is Elk Springs in Moffat County, northeast of the Rangely field. The discovery well produced about 150 barrels daily from Weber (Pennsylvania) sand at a depth of 6,087–6,140 feet. This discovery is a result of the widespread exploratory effort directed to this region by the spectacular success of the Rangely development, which ranks as one of the largest reserves opened in recent years.

Production of crude petroleum in Colorado, 1942–46, by fields

[Thousands of barrels]

Year	Fort Collins-Wellington	Hiawatha	Iles	Moffat	Price	Powder Wash	Rangely	Tow Creek	Walden	Wilson Creek	Other fields [1]	Total
1942	111	185	534	125	272	37	288	46	-------	533	68	2,199
1943	102	164	480	118	253	44	285	46	-------	760	68	2,320
1944	96	100	454	112	247	50	393	44	38	1,401	148	3,083
1945	143	66	429	105	238	67	1,565	38	158	2,053	174	5,036
1946 [2]	135	45	441	93	239	24	8,314	39	188	2,381	117	12,016

[1] Includes crude oil consumed on leases and net change in stocks held on leases for entire State.
[2] Subject to revision.

Florida.—Production from the State's only field, Sunniland in Collier County, increased from 30,000 barrels in 1945 to 57,000 in 1946. Two additional wells were completed in 1946 in the single producing formation, reported as the Young dolomite member of the Glen Rose formation.

Twenty-four exploratory wells were drilled in 1946—all unsuccessful.

Illinois.—After 5 years of decline, crude production increased from 75,094,000 barrels in 1945 to 75,297,000 in 1946, owing to a higher rate of production during the 1946 summer months. Changes in production by fields were relatively small, except at Mattoon, Coles County, which under intensive development produced about 4,200,000 barrels of oil in 1946 compared with less than 500,000 barrels in 1945.

Oil-well completions numbered 1,344 in 1946 and 1,060 in 1945, influenced by the drilling campaign in the Mattoon field, which was materially enlarged. Oil completions in the most active fields were: Mattoon 297, Clay City 122, Stokes-Brownsville 84, Marine 53, Calhoun 48, and Herald 47.

Thirty-one new pools were discovered and many extensions proved by step-out wells. Most new pools were relatively close to production. The more important of these appeared to be South Stanford and Hoosier in Clay County, Central Lancaster, North Friendsville, and North Maud in Wabash County, and East Covington in Wayne County. A total of 635 holes classed as exploratory resulted in 96 commercial oil wells. Wayne, White, and Clay Counties were the most active in exploration among many counties involved.

Most of the new oil, as well as developed production in Illinois, is from horizons in rocks of Mississippian age. However, some interest

is reported by Dr. A. H. Bell of the Illinois Geological Survey in testing for Silurian production along the western side of the Illinois Basin and for production in pre-St. Peter Ordovician and Cambrian strata on the Pittsfield-Hadley anticline in western Illinois.

Production of crude petroleum in Illinois, 1942–46, by fields, in thousands of barrels

[Oil and Gas Journal]

Field	1942	1943	1944	1945	1946
Albion	499	405	858	1,234	898
Benton	5,488	2,534	1,655	1,217	927
Bible Grove	286	763	985	1,757	1,491
Boyd			135	1,372	1,497
Bridgeport	2,027	1,880	1,932	2,144	2,272
Centralia	2,277	1,683	1,785	1,729	1,887
Clay City	3,533	2,764	4,890	5,104	5,309
Dale-Hoodville	5,294	3,909	3,160	2,022	1,479
Dundas	2,505	1,295	780	873	935
Iola	18	1,003	1,085	724	561
Johnsonville	5,146	2,170	1,460	1,119	1,206
Keensburg	1,710	1,138	873	757	663
Louden	17,961	13,702	11,175	9,463	8,243
Mount Carmel	1,024	854	1,330	923	868
New Harmony	7,224	5,257	4,395	3,429	2,866
Patoka	969	774	940	1,574	1,651
Phillipstown	182	1,112	985	1,244	1,038
Robinson	1,391	1,273	1,078	1,095	1,118
Roland	1,889	1,120	760	936	752
Rural Hill	3,738	1,715	925	679	510
Salem	14,705	10,220	8,310	6,637	5,967
St. James	1,477	1,130	930	796	706
Woodlawn	2,997	1,446	960	950	792
Other fields	23,942	22,582	24,436	25,682	30,977
Total Illinois	106,282	80,729	75,822	73,460	74,613

Indiana.—Production of petroleum increased from 4,868,000 barrels in 1945 to 6,726,000 in 1946, reflecting increased development activity in the southwestern producing district. The leading fields, with 1946 production in thousands of barrels, were: Griffen 1,732, New Harmony South 1,204, Owensville North 739, New Harmony 415, and Mt. Vernon 373.

Oil-well completions tripled over 1945 to 330, with oil completions in most active fields as follows: New Harmony South 65, Mt. Carmel East 44, Owensville North 42, and Union-Bowman 26. Wildcat wells, of which there were 118, were concentrated chiefly in Posey (25) and Gibson (24) Counties; the remainder being widely scattered. Seventeen of these were completed as oil wells.

Production of crude petroleum in Indiana, 1942–46, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1942	620	524	604	594	627	588	579	571	529	532	485	490	6,743
1943	482	441	458	451	427	435	460	440	434	425	414	416	5,283
1944	417	422	450	437	425	408	406	434	426	444	428	421	5,118
1945	425	387	360	359	427	407	428	442	387	417	402	427	4,868
1946 [1]	482	504	599	605	611	577	578	568	545	580	519	558	6,726

[1] Subject to revision.

Among new pool discoveries the most promising appeared to be New Harmony East and Springfield in Posey County and Princeton North in Gibson. Extensions of Dodds Bridge, Troy, New Harmony South, and Griffen fields, among others, were reported.

Deep tests penetrated the Trenton limestone under Griffen field production, the Glenwood-St. Peter formation in Owen and Clay Counties, and the Mt. Simon sandstone (Cambrian) in Jasper County.

Kansas.—The production of Kansas oil fields has been relatively stable through the war period. Small declines in 1944 and 1945 were reversed by a 1-percent gain in 1946 to 97,218,000 barrels. Principal areas of higher production were Kraft-Prusa-Feltes and the leading Trapp-Sellens field.

Increased drilling, related to closer spacing of wells in proved areas, resulted in 1,055 oil-well completions in 1946, an increase of 217 over 1945. Development was widespread but most active, as indicated by oil-well completions in: Trapp 127, Kraft-Prusa 61, El Dorado 46, Chase 43, and Stoltenburg 33. In the Hugoton gas field, 265 gas wells were drilled.

In all, 307 wildcat wells were drilled in 1946—31 of these being successful oil wells. Prominent among the discoveries was Hickory Creek in Butler County, producing from Bartlesville sand. By the end of 1946, production had exceeded 120,000 barrels from 13 wells. The Boggs pool, Barber County, is expected to contain a considerable reserve of oil in Simpson sand. Except for a few scattered developments in counties to the east, the discoveries were roughly alined in the counties from Rooks and Ellis on the north to Pratt and Barber on the south. The majority of these areas found oil in the Arbuckle limestone; a few in the Lansing, Mississippi, and Viola limestones, and one in the Reagan sand (Rush County).

Near the year end, indications of important discoveries were reported in wells in Barber, Ellis, Harvey, and Kingman Counties.

Production of crude petroleum in Kansas, 1942–46, by selected fields, in thousands of barrels

[Oil and Gas Journal]

Field	1942	1943	1944	1945	1946
Bemis-Shutts	4,978	5,764	4,885	5,160	5,305
Bornholdt [1]	1,857	1,830	1,591	1,412	1,057
Burnett	4,097	4,948	3,715	3,189	2,873
Burrton [2]	2,101	1,740	1,525	1,351	1,209
Carmi		662	2,067	1,161	986
Chase [3]	3,379	3,750	3,702	3,076	2,766
Geneseo-Edwards	3,716	3,941	3,268	3,181	3,220
Gorham	2,734	2,528	2,286	2,068	1,891
Hall-Gurney	4,057	3,780	3,750	3,410	3,455
Kraft-Prusa-Feltes	3,233	4,158	4,086	4,590	5,257
Morel	296	570	912	1,076	1,098
Peace Creek	1,650	2,914	1,638	1,305	1,419
Ray	731	1,140	1,172	1,147	1,213
Ritz Canton	1,145	960	864	742	721
Silica-Raymond	9,063	9,825	7,834	6,422	5,691
Stoltenberg-Wilkins	2,711	3,083	2,818	2,740	2,747
Trapp-Sellens	9,726	10,840	9,347	10,631	11,042
Zenith	3,593	3,765	3,624	2,912	1,521
Other fields	37,812	39,499	40,773	40,923	43,108
Total Kansas	96,879	105,697	99,857	96,496	96,579

[1] Included Welch prior to 1945. [2] Includes Haury in 1945–46. [3] Included Campbell prior to 1944.

Kentucky.—Crude-oil production in Kentucky continued an upward trend to set another record for the State in 1946. The total for 1946 was 10,578,000 barrels, compared with 10,325,000 in 1945. Western Kentucky continued to produce about 82 percent of the total; but there was a relative shift in the other areas as Eastern Kentucky dropped from a level of 16 percent to 13 percent and the South-Central producing area increased from a 2-percent contribution in 1945 to 5 percent of the total in 1946. Production in Henderson County recorded a marked gain for the year and the output in Union County declined but the combined total from these two counties accounted for 63 percent of the State total. In Southern Kentucky the only important increase in production came from Clinton County where the output rose above 400,000 barrels.

The number of oil wells completed in 1946 declined for both the Eastern and Western areas but increased for the Southern area. This increase in Southern Kentucky was due to the rapid expansion in Clinton County where over 95 percent of the drilling for this area took place. In this South-central area only five wells were drilled outside of Clinton County and all were dry holes. One of these, a well near McKinney in Lincoln County, attracted particular attention as the deepest well (6,117 feet) ever drilled in the State. The Uniontown pool, in Western Kentucky, which ranks first as a crude producer, was relatively quiet in 1946 with few tests drilled, while active drilling continued in Henderson County, particularly in the following pools: Pool, Smith Mills, and Henderson.

Seven oil pools were discovered, three in Henderson County, two in McLean County, and two in Daviess County. None of the new fields represented outstanding discoveries, but development drilling resulted in several important extensions to existing fields.

Production of crude petroleum in Kentucky, 1942–46, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1942	344	335	376	356	348	355	361	337	357	408	460	497	4,534
1943	476	513	526	564	640	664	737	732	774	825	759	673	7,883
1944	695	663	720	647	748	759	783	886	870	969	969	912	9,621
1945	911	791	665	837	905	850	893	886	814	898	982	893	10,325
1946 [1]	866	835	929	907	940	897	922	906	866	875	812	823	10,578

[1] Subject to revision.

Louisiana.—A gradual upward trend in crude-oil production through 1946 raised the year's total to the record level of 143,303,000 barrels, compared with 131,051,000 barrels in 1945. A 3-year decline in production from Northern district fields was reversed abruptly by gains of 4.5 and 2.5 million barrels in output of the rapidly developing Delhi and Lake St. John fields, respectively, and 1.0 million barrels at Haynesville, where gas-pressure maintenance operations and a new pay zone were instrumental in halting a rapid decline.

In the Gulf district production increased 5 percent to 112,535,000 barrels aided by modest gains in most producing fields, among which Delta Farms, Egan, Good Hope, Tepetate, Vinton, and Bayou Sale were the leaders.

Oil-well completions numbered 363 in the Gulf district in 1946, a decline from 407 reported in 1945. Oil wells drilled in the most active fields were: Vinton 20, Egan and Golden Meadow 19 each, Delta Farms 17, Mamou 12, West Tepetate 11, and Bayou Sale 10. Major additions to oil reserves by extension or discovery of new producing zones were made at Weeks Island, Iberia Parish; Vinton, Calcasieu Parish; and Bayou de Fleur, a 1946 discovery in Jefferson and Plaquemines Parishes.

In the Northern district oil-well completions increased from 239 in 1945 to 450 in 1946 owing largely to intensive development at Delhi and adjacent new fields. At Big Creek 123 oil wells were drilled and at Delhi 88, during which the 2 fields merged into 1, over 17 miles in length, structurally a stratigraphic type reservoir skirting the south flank of the Monroe uplift. Other active fields, with the number of oil wells drilled, were: Caddo 107, Lake St. John 41, and Haynesville 14.

In the Gulf district 140 exploratory wells discovered 9 oil fields and 5 gas-condensate fields, ranging in depth from 7,680 feet to over 12,600 feet. A large number of new deep productive zones were opened, some of which encouraged the practice of flank drilling down the sides of domal structures. At Weeks Island, the deepest producing well in the world was completed at 13,780 feet in Miocene sand, flowing 550 barrels daily of 33° gravity oil through a small choke.

In the Northern district 114 wildcat wells discovered 5 oil and 2 condensate fields. The oil fields were: Plain Dealing in Bossier Parish, South Big Creek in Franklin, Ashland in Natchitoches, Lake End in Red River, and Negreet in Sabine. Condensate fields were at Killens Ferry, Franklin Parish, and Choudrant, Lincoln Parish. Notable extensions to productive areas were made at Big Creek, Delhi, and Lisbon.

Production of crude petroleum in Louisiana, 1942–46, by districts and fields

[Thousands of barrels]

District and field	1942	1943	1944	1945	1946 [1]
Gulf Coast:					
Anse la Butte	2,235	2,191	2,620	2,481	2,448
Avery Island	21	180	582	928	1,223
Barataria	1,081	1,129	1,135	1,367	1,523
Bayou Sale	943	1,908	3,112	2,903	3,479
Black Bayou	895	1,101	1,019	686	723
Bosco	1,375	1,094	1,046	1,000	1,068
Caillou Island	1,519	1,829	1,939	1,917	2,054
Chacahoula	618	937	937	754	680
Chalkley	1,514	1,496	1,254	1,037	765
Charenton	1,380	1,116	1,040	1,048	1,200
Delta Farms	309	1,013	2,218	3,372	4,510
East White Lake	217	562	1,044	1,219	1,427
Egan		6	48	417	1,453
Eola	3,313	3,137	3,158	2,467	1,721
Garden Island	1,256	1,357	1,256	1,139	1,168
Gibson	1,324	2,543	3,542	3,384	2,555
Golden Meadows	4,424	3,606	2,796	2,494	2,400
Good Hope			26	770	1,745
Grand Bay	2,010	2,522	2,724	3,033	3,122
Grand Lake	1,153	951	841	733	666
Gueydan	1,048	1,504	1,963	2,071	2,200
Hackberry	3,316	3,725	4,057	3,776	3,794
Iowa	2,506	2,928	3,309	2,731	2,486
Jennings	4,402	3,416	2,840	2,442	2,025
Lafitte	3,750	4,688	4,452	4,139	4,374

See footnotes at end of table.

Production of crude petroleum in Louisiana, 1942–46, by districts and fields—Con.

[Thousands of barrels]

District and field	1942	1943	1944	1945	1946 [1]
Gulf Coast—Continued					
Lake Pelto	222	382	645	913	1,302
Lake Salvador	718	988	1,554	1,595	1,632
Leeville	981	1,214	1,421	1,575	1,381
Neale	884	1,333	2,342	2,301	1,501
New Iberia	2,287	2,606	2,615	2,152	1,744
North Crowley	1,803	1,699	1,624	1,648	1,526
Paradis	2,246	4,173	4,013	3,652	3,688
Pine Prairie	842	1,402	1,944	1,942	1,821
Port Barre	965	1,215	1,176	1,008	1,103
Quarantine Bay	2,107	2,567	2,877	2,977	3,227
Roanoke	612	600	764	836	924
St. Gabriel	1,345	1,732	1,957	1,911	1,741
Sulphur	700	801	741	792	722
Tepetate (inc. north and west)	1,000	912	901	1,931	2,936
University	3,289	2,896	2,338	1,982	1,884
Venice	1,294	2,147	3,334	3,315	3,030
Ville Platte	6,446	4,450	3,642	2,502	2,588
Vinton	369	661	1,942	2,703	3,372
West Bay	743	878	1,055	1,222	1,246
West Lake Verrett	872	837	1,015	1,004	1,136
White Castle	907	1,271	1,437	1,250	1,013
Other Gulf Coast [2]	15,234	16,491	17,336	19,862	22,209
Total Gulf Coast	86,475	96,194	105,631	107,381	112,535
Northern:					
Caddo	2,694	2,421	2,129	1,950	1,944
Delhi			2	1,054	5,525
Haynesville	4,621	5,368	3,816	2,356	3,321
Holly Ridge			749	1,429	1,254
Homer	1,060	1,067	1,019	976	926
Lake St. John	62	306	623	1,882	4,381
Nebo [3]	3,424	3,668	3,466	3,191	2,805
Olla [4]	6,107	4,852	4,221	3,636	3,109
Rodessa	4,100	3,462	2,930	2,515	1,978
Shreveport	923	777	690	513	406
Urania	778	739	678	632	615
Other Northern [2]	5,541	4,738	3,691	3,536	4,504
Total Northern	29,310	27,398	24,014	23,670	30,768
Total Louisiana	115,785	123,592	129,645	131,051	143,303

[1] Subject to revision.
[2] Includes crude oil consumed on leases and net change in stocks held on leases for entire district.
[3] Includes Hemphill, Trout Creek, and Jena.
[4] Includes Little Creek and Summerville.

Michigan.—Production in 1946 amounted to 17,074,000 barrels—a decline of 1 percent compared with decreases of 7 percent in 1945, 11 percent in 1944, and 5 percent in 1943. The major increases of about 1,000,000 barrels from the Deep River field and 600,000 from Coldwater failed to compensate for declines at Reed City, Fork, and other fields. Reed City continued as the leading producer, even after a 24-percent drop from the preceding year.

The total of 234 oil wells, completed in 1946, included 19 wildcats, but at present none of the discoveries appear very large. The more promising new fields are Brenner and Hawkhead, both in Allegan County and both producing from Traverse limestone. At the end of 1946, 16 wells had been drilled in developing the Brenner field and 13 in the Hawkhead field. Other intensively developed fields, with the number of oil wells completed in 1946, include: Deep River 40, Coldwater 19, Kawkawlin 14, and East Norwich 10.

Shallow-drilling exploration to determine the elevation of strata below the glacial drift was continued throughout the year, and 173 shallow tests were drilled.

Production of crude petroleum in Michigan, 1942–46, by fields, in thousands of barrels

[Michigan Department of Conservation]

Year	Adams	Cold-water	Deep River	East Norwich	Fork	Headquarters	Kawkawlin	Porter	Reed City	Winterfield	Other fields	Total
1942	1,030	-------	-------	3	53	2,321	492	891	9,102	1,259	6,603	21,754
1943	984	-------	-------	25	805	1,999	689	742	7,847	683	6,994	20,768
1944	1,177	68	736	184	1,436	1,212	724	626	5,194	377	6,756	18,490
1945	1,196	958	1,460	428	1,566	461	654	521	4,267	223	5,533	17,267
1946	1,299	1,598	2,409	439	1,354	226	697	462	3,250	172	5,168	17,074

Mississippi.—Petroleum production increased 27 percent in 1946 to 24,216,000 barrels in response to further development or recently discovered fields. Tinsley remained the largest producing field, but its output declined from 9.3 million barrels in 1945 to 8.1 million in 1946. Other leading fields, with 1946 production in thousands of barrels, were: Cranfield 4,473, Heidelberg 4,104, Baxterville 2,420, Eucutta 2,389, and Pickens 1,773.

Oil-well completions declined from the high level of 1945 (198) to 154 in 1946 as drilling in the leading fields of 1945, particularly Heidelberg and Eucutta, passed its peak. Oil wells added in active fields in 1946 were: Cranfield 31, Baxterville 22, Heidelberg 21, Brookhaven 19, Eucutta 17, and Guinville 8.

Of 79 wildcat wells drilled, only 2 found commercial oil production. These wells opened two fields in Adams County: Pine Ridge producing from Wilcox sand below 5,600 feet and La Grange producing initially from lower Tuscaloosa and, upon recompletion, from Wilcox sand. Significant additions to reserves were made by extension or opening of new productive zones in the Fayette, Brookhaven, Mallilieu, La Grange, and Tinsley (by deeper drilling) fields. Condensate reserves were added at Hub and Cranfield.

Production of crude petroleum in Mississippi, 1942–46, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1942	2,489	2,601	2,708	2,885	2,648	2,531	2,469	2,366	2,194	2,126	1,953	1,863	28,833
1943	1,766	1,589	1,639	1,679	1,655	1,612	1,585	1,574	1,470	1,438	1,408	1,392	18,807
1944	1,343	1,268	1,267	1,250	1,244	1,295	1,354	1,401	1,384	1,476	1,508	1,547	16,337
1945	1,514	1,451	1,582	1,564	1,590	1,553	1,625	1,690	1,556	1,633	1,632	1,672	19,062
1946 [1]	1,697	1,554	1,663	1,707	1,918	1,921	1,981	2,220	2,187	2,362	2,407	2,599	24,216

[1] Subject to revision.

Montana.—Larger output from the Montana portion of Elk Basin and from the Cat Creek field raised crude-oil production of the State from 8,420,000 barrels in 1945 to 8,801,000 barrels in 1946. The

Cut Bank field produced 4,546,000 barrels, about 300,000 less than in 1945, and Kevin-Sunburst declined 7 percent to 1,772,000 barrels. The Elk Basin produced 1,355,000 barrels in 1946 and Cat Creek 480,000 barrels, stimulated by the discovery of new production in the Ellis sand and the Madison formation.

A decline in drilling activity, particularly at Cut Bank, was reflected in the reduction in number of oil-well completions from 217 in 1945 to 159 in 1946. Completions by leading fields in 1946 were: Kevin-Sunburst 58, Cut Bank 57, Cat Creek 25, and Pondera 6.

Forty-seven wildcat wells were drilled, of which 11 found oil production—7 in Petroleum County, 3 in Glacier, and 1 in Toole. Two oil fields were discovered: Rattlesnake Butte in Petroleum County (Second Cat Creek sand) and West Kevin in Toole County producing from Ellis-Madison. New pay sands were found at East Utopia, Liberty County (Devonian gas), and at Cat Creek, east and west. Extension of Madison limestone production at Cut Bank probably added most significantly to crude reserves in 1946.

Production of crude petroleum in Montana, 1942–46, by fields

[Thousands of barrels]

Year	Cat Creek	Cut Bank	Dry Creek	Elk Basin	Franie	Gage	Kevin-Sunburst	Pondera	Other fields [1]	Total
1942	138	5,509	110	16	21	-------	1,992	264	24	8,074
1943	120	5,328	97	243	14	-------	1,840	211	63	7,916
1944	116	5,414	92	682	15	98	1,923	241	66	8,647
1945	130	4,876	166	936	19	80	1,912	262	39	8,420
1946 [2]	480	4,546	160	1,355	16	104	1,772	306	62	8,801

[1] Includes crude oil consumed on leases and net change in stocks held on leases for entire State.
[2] Subject to revision.

Nebraska.—Production in 1946 amounted to 265,000 barrels compared with 305,000 barrels in 1945 and 1,898,000 barrels in the peak year 1941. The Falls City field accounted for about 57 percent of the total, Barada about 33 percent, and Dawson and Shubert the remaining 10 percent. All producing fields are in Richardson County.

The number of completions totaled 3 in 1946 compared with 13 in 1945. Four of the six tests were exploratory and resulted in dry holes. The Barada field was extended a short distance by completion of an oil well that had an initial production of 60 barrels daily from the Hunton limestone.

Production of crude petroleum in Nebraska, 1942–46, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1942	115	117	122	118	116	113	104	99	90	87	78	78	1,237
1943	66	61	71	62	62	56	52	52	49	37	36	31	635
1944	37	26	39	37	35	34	38	40	35	34	32	30	417
1945	25	28	21	31	28	26	26	26	22	27	19	26	305
1946 [1]	25	21	22	25	27	24	25	23	20	20	18	15	265

[1] Subject to revision.

New Mexico.—Further declines in most leading fields reduced production of crude petroleum from 37,351,000 barrels in 1945 to 36,860,000 in 1946. Offsetting part of the declines in older fields were increased withdrawals from the rapidly developing Drinkard, Paddock, and Brunson pools (parts of which overlap) in Lea County. The only important older field to show a production gain was Eunice, which produced 300,000 barrels more oil in 1946 than in 1945.

Oil-well completions increased from 279 in 1945 to 294 in 1946; of the latter, 286 were in the Southeast district and 8 in the Northwest. In the Southeast 38 wildcat wells resulted in 3 oil wells in Lea and 1 in Eddy County. Six wildcats in the Northwest were unproductive.

Oil completions in leading fields were: Drinkard 50, Paddock 34, Caprock 30, Grayburg-Jackson 29, and Square Lake 22.

The only new field discovery—Bitter Lake, Chaves County, producing from shallow San Andres limestone—was apparently of small importance. Large extensions of the important Drinkard, Paddock, and Brunson pools were made, and drilling at Caprock was revived by extension to the southeast.

A continuing trend toward deeper drilling was evident in Southeast New Mexico. Interest in the Delaware Basin was heightened by a deep well that revealed 12,000 feet of Permian sediments showing evidence of oil and gas in several zones.

In the San Juan Basin on the northwest, intensive exploratory and leasing activity progressed in 1946. Great interest was shown in two deep tests that were drilling at the end of the year.

Production of crude petroleum in New Mexico, 1942–46, by districts and fields, in thousands of barrels

[Oil and Gas Journal]

Year	Southeast									Northwest	Total
	Arrowhead	Eunice	Grayburg-Jackson	Hobbs	Loco Hills	Maljamar and South	Monument	Vacuum	Other		
1942	1,195	5,242	1,566	2,928	1,583	1,740	6,698	3,443,	8,317	280	32,992
1943	1,703	6,498	1,914	3,780	1,296	1,853	7,190	4,953	9,312	425	38,924
1944	1,946	6,470	1,983	4,120	1,119	2,117	7,570	5,080	8,898	448	39,751
1945	1,839	5,707	1,952	3,874	993	[1] 2,086	7,139	4,585	9,056	[2] 455	37,686
1946	1,691	6,007	1,811	3,569	914	2,033	6,565	4,054	9,594	[2] 466	36,704

[1] Oil Weekly.

[2] Bureau of Mines.

New York.—Production of crude petroleum increased in 1946 for the first time since 1942—to 4,863,000 barrels from 4,648,000 barrels in 1945.

The rate of drilling increased over 1945, oil-well completions numbering 795 compared with 723 a year earlier. In all, 735 input wells were drilled in 1946 in connection with secondary-recovery operations.

No exploratory drilling for oil was reported.

Production of crude petroleum in New York, 1942–46, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1942	453	405	454	458	455	467	474	456	459	461	425	454	5,421
1943	418	389	453	427	432	436	438	429	423	403	401	410	5,059
1944	387	381	399	375	419	402	332	480	392	393	376	361	4,697
1945	363	329	386	382	417	386	395	431	377	421	394	367	4,648
1946 [1]	418	370	398	416	424	405	404	416	397	428	383	404	4,863

[1] Subject to revision.

Ohio.—In 1942–45 crude production in Ohio declined steadily from 3,543,000 barrels to 2,828,000. This declining trend was broken by a slight increase in production in 1946, when the total for the State was 2,908,000 barrels—a gain of 3 percent. The increased production of Pennsylvania Grade within the State compensated for the declines in production of other grades to produce the small net gain for the year. Almost 60 percent of the 1946 output was Pennsylvania Grade.

Oil-well completions in 1946 increased about 35 percent over 1945 for the largest gain in recent years. The year was marked by the relative increase in the number of oil-well completions to 26 percent of total wells drilled and by the percentage decline of dry holes from 37 in 1945 to 32 in 1946. Muskingum County recorded the largest number of oil-well completions, followed in order by Meigs, Perry, Monroe, Licking, and Washington.

About 65 exploratory wells were drilled in 1945, including 4 listed as oil wells, but no important discoveries of new oil resulted. However, a number of development wells resulted in extensions to existing fields in Perry, Muskingum, and Meigs Counties. In all, about 1,800 acres were added to Clinton territory and 1,000 acres to Berea.

Production of crude petroleum in Ohio, 1942–46, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1942	277	262	296	317	297	322	319	297	300	308	280	268	3,543
1943	253	244	293	273	278	285	286	303	278	274	276	279	3,322
1944	253	232	263	229	276	247	190	295	240	257	237	218	2,937
1945	195	208	258	233	251	246	248	265	229	258	223	214	2,828
1946 [1]	234	214	242	248	260	245	238	243	242	260	235	247	2,908

[1] Subject to revision.

Oklahoma.—With reversal of the upward trend of production from West Edmund, the State's greatest current source of oil, production in 1946 declined to 134,497,000 barrels from the 1945 total of 139,299,000 barrels. Material reductions in output of West Edmund, Oklahoma City, Pauls Valley, the Seminole district, and many other fields were not offset by the few scattered gains at Velma, Moore, Hewitt, and the old Glenn-Sapulpa area.

The upward trend in oil-well completions continued for the third successive year—1,654 new wells in 1946 comparing with 1,426 in 1945. New oil wells in the most active fields were: Cache Creek 180, Velma 74, West Edmund 72, Soldier Creek 48, Cement 43, and Lone Grove 31. Much of the new drilling was related to 1946 shallow-sand

discoveries in Cotton County, among which were Cache Creek and Soldier Creek.

Exploratory completions increased over 20 percent in 1946 to 573 of which 92 were successful oil wells. Most of the discoveries were in Seminole and adjacent Counties and southwestward from Seminole to Cotton County, which was the most active in exploratory drilling owing to discovery of prolific oil production from Pennsylvanian sand at depths approximating 1,400 feet. Deeper drilling in search of oil accumulations in the southeastern portion of the great Anadarko Basin was actively carried on—over 100 wildcat wells having been drilled in the Garvin-McClain-Stephens County area. Testing in the deeper parts of the basin in western Oklahoma resulted in gas production in Washita County (Springer sand); oil production in Major (Prue sand) and Garfield Counties ("Wilcox" sand); and a dry hole (12,610 feet) in Dewey County, which found a showing of oil and gas in Pennsylvanian sand probably below 9,000 feet. In all, 51 new oil fields were reported in Oklahoma in 1946 and numerous extensions and new productive zones in existing fields. Among the more important discoveries from the standpoint of reserves were: Southwest Antioch, Southwest Maysville, and Northeast Butterly in Garvin County, Soldier Creek and Cache Creek in Cotton County, and Coon Creek in Logan County.

Production of crude petroleum in Oklahoma, 1942–46, by fields, in thousands of barrels

[Oil and Gas Journal]

Field	1942	1943	1944	1945	1946
Allen	1,365	1,245	1,285	1,256	[1] 1,120
Apache	1,740	2,309	2,245	2,308	1,591
Beebe	1,152	1,057	840	723	661
Billings	2,064	1,706	1,490	1,296	820
Burbank	3,356	3,251	3,140	3,128	2,927
Cement	3,211	2,564	4,190	5,165	4,801
Coyle	1,660	1,627	1,185	991	719
Crescent	752	752	1,124	1,845	1,557
Cromwell	2,380	1,761	1,512	1,277	1,094
Cumberland	2,776	3,735	4,414	4,119	3,696
Cushing-Shamrock	3,069	2,991	2,940	2,814	2,792
Edmond	1,136	1,161	1,046	902	583
Fitts	3,050	2,489	2,150	1,701	1,518
Glenn-Sapulpa	1,527	1,856	2,245	2,359	2,418
Healdton	2,827	2,618	2,515	2,423	2,438
Hewitt	3,304	2,382	2,055	1,084	1,698
Keokuk	1,012	678	560	530	582
Lucian	1,877	1,575	1,363	994	803
Moore—South and West			351	1,392	2,276
Oklahoma City	26,484	20,338	16,295	12,968	10,693
Pauls Valley	823	1,963	4,200	4,445	2,971
Ramsey	1,664	1,590	1,250	999	799
Seminole district:					
Bowlegs	1,900	1,721	1,525	1,250	1,169
Carr City	662	602	555	514	456
Earlsboro	3,718	3,253	2,495	1,737	1,095
Little River	2,333	1,931	1,741	1,492	1,159
St. Louis-Pearson	5,687	3,828	2,690	1,703	1,500
Seminole City	2,854	2,555	2,240	1,990	1,307
Sholem-Alechem-Tatums-Tussy	2,490	2,275	2,486	2,208	2,160
South Burbank	2,728	2,637	2,500	2,370	1,886
Velma	439	602	800	1,024	2,457
West Edmond		322	7,752	26,548	23,565
Other fields	46,721	41,185	40,257	43,824	51,917
Total Oklahoma	136,761	120,559	123,436	139,379	137,228

[1] Includes Allen Deep only.

The Keyes area in eastern Cimarron County, a 1945 discovery, was extended in 1946 and had five wells at the end of the year. The producing formation is a Pennsylvanian sand at about 4,860 feet.

Pennsylvania.—Crude production in Pennsylvania had followed a downward trend since 1942 but changed in 1946 as the reported output rose to 12,996,000 barrels compared with 12,515,000 in 1945—a gain of 481,000 barrels or about 4 percent. About 80 percent of all crude production in the State came from the Pennsylvania portion of the Bradford field. The entire Bradford field, including the part in New York, supplied about 52 percent of the total Pennsylvania-Grade crude-oil production of the Appalachian area.

About 75 percent of all wells drilled in Pennsylvania are connected with secondary-recovery operations, and some well-completion series include part of these secondary-recovery wells as oil wells. In addition to the oil wells drilled as a part of these recovery projects, about 200 oil-well completions were recorded for new pools or extensions of old fields in 1946. Less than 20 percent of these completions were in the Southwestern area compared with over 80 percent of the total in McKean County. In this county, the most important development-drilling activity was in the Coryville pool in the northeastern part of the county. This pool was discovered in 1945 and in 1946 was extended to include approximately 1,800 acres. This development accounted for 163 of the total oil-well completions for the year. The greatest drilling activity in Southwestern Pennsylvania was the development of the Young pool in Washington County. This pool, discovered in 1945, was extended to include about 390 acres by the end of 1946. Continued secondary-recovery activity in the Bradford field was indicated by the drilling of 2,503 new wells, about half of which were water-intake wells compared with 2,351 in 1945.

Production of crude petroleum in Pennsylvania, 1942–46, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1942	1,501	1,332	1,518	1,582	1,522	1,560	1,526	1,508	1,481	1,502	1,359	1,388	17,779
1943	1,358	1,229	1,419	1,348	1,367	1,368	1,359	1,330	1,290	1,246	1,228	1,215	15,757
1944	1,202	1,149	1,264	1,183	1,292	1,206	1,032	1,367	1,160	1,151	1,098	1,014	14,118
1945	1,015	919	1,096	1,043	1,109	1,097	1,082	1,111	996	1,089	995	963	12,515
1946 [1]	1,074	956	1,066	1,120	1,134	1,092	1,049	1,132	1,082	1,160	1,056	1,075	12,996

[1] Subject to revision.

Texas.—Production in the early months of 1946 remained below the level of a year earlier but increased to record levels in July and was maintained at a high rate for the balance of the year. The 1946 total—760,505,000 barrels—exceeded the 1945 record by 5.8 million barrels. The principal gain was in West Texas (16.6 million barrels) where output was limited by transportation facilities rather than capacity to produce at efficient rates. South and North Texas districts increased their production over 1945 5.8 and 2.9 million barrels, respectively. A reduction of 9.9 million barrels was reported in Gulf Coast production and 7.4 million barrels in the East Texas district. A decline of 10.1 million barrels in production of the East

Production of crude petroleum in Texas, 1942–46, by districts and fields

[Thousands of barrels]

District and field	1942	1943	1944	1945	1946 [1]
Gulf Coast:					
Agua Dulce	795	1,904	3,511	3,811	3,786
Amelia	1,375	1,668	1,682	1,491	1,493
Anahuac	3,589	8,906	11,932	11,168	10,137
Barbers Hill	2,879	2,340	2,069	1,895	1,853
Bay City	589	1,222	1,761	1,425	1,420
Clear Lake	647	1,468	1,872	1,424	1,366
Conroe	13,514	19,967	23,231	21,378	20,708
Dickinson-Gillock	2,073	2,128	2,377	2,138	2,077
Fairbanks	2,784	2,802	2,910	2,644	2,287
Fannette	457	1,242	1,657	2,692	3,337
Fig Ridge	237	862	2,516	2,862	2,614
Flour Bluff	426	1,009	1,490	1,435	1,282
Friendswood	3,615	11,420	20,930	20,075	18,781
Greta	1,132	1,499	3,375	3,233	3,448
Hardin	1,091	1,372	1,330	1,157	978
Hastings	10,412	17,964	22,169	20,961	19,317
Heyser	2,926	3,337	3,338	2,807	2,283
High Island	880	805	839	868	971
Hull	2,217	1,879	1,645	1,472	1,231
La Rosa	365	676	1,681	1,469	1,340
Livingston	[2]	[2]	659	1,273	1,712
Lolita	2,269	1,887	2,146	2,288	2,307
Lovell's Lake	1,784	2,040	1,891	1,765	1,806
Luby	782	1,276	1,581	1,315	1,014
Manvel	1,906	2,665	3,024	2,824	2,635
Markham	531	973	2,409	2,403	1,984
Midway	873	1,082	1,198	1,230	1,109
Old Ocean	3,701	4,785	5,517	6,107	6,088
Oyster Bayou	134	1,222	2,267	2,088	2,061
Placedo	1,228	1,730	2,265	2,324	2,177
Raccoon Bend	1,587	2,646	3,675	3,375	2,834
Refugio	1,542	1,509	1,839	1,918	2,418
Saxet-Saxet Heights	2,728	2,677	2,685	2,142	2,498
Segno	1,290	1,599	1,394	1,355	1,282
Silsbee	719	720	746	867	1,137
South Houston	667	1,586	1,865	1,785	1,558
Stowell	257	1,747	5,522	6,330	4,924
Stratton	683	1,732	4,090	4,016	3,604
Sugarland	614	1,779	3,084	2,448	1,721
Thompsons	5,392	9,993	13,609	13,007	13,136
Tomball	3,146	3,257	3,781	3,728	3,711
West Columbia	1,984	2,041	2,584	2,595	2,314
West Ranch	5,249	6,762	8,102	7,122	7,116
White Point	2,934	3,905	4,537	4,525	3,849
Withers-Magnet	4,165	6,015	6,749	7,391	6,847
Other Gulf Coast [3]	36,852	50,030	61,220	60,348	60,551
Total Gulf Coast	135,020	200,128	260,754	252,969	243,102
East Texas:					
East Texas proper [4]	122,799	129,983	135,184	131,204	121,080
Cayuga	4,066	3,459	2,998	2,633	2,456
Chapel Hill	979	1,293	1,245	774	567
Hawkins	5,451	14,243	13,178	12,436	14,843
Long Lake	1,463	1,558	1,995	2,042	2,072
New Hope		124	986	1,640	1,284
Quitman	3	642	2,083	2,158	2,331
Rodessa	3,166	2,821	2,209	1,716	1,333
Sulphur Bluff	1,549	1,510	1,426	1,338	1,247
Talco	9,522	9,266	8,618	8,248	8,755
Van	3,444	6,411	11,673	10,968	10,625
Other East Texas	840	1,515	2,725	3,729	4,904
Total East Texas	153,282	172,825	184,320	178,886	171,497
Central Texas:					
Darst Creek	2,220	2,779	3,438	3,188	2,595
Luling	1,754	1,645	1,551	1,469	1,321
Mexia-Powell [5]	1,480	1,339	1,290	1,209	1,144
Salt Flat (Bruner)	1,118	909	817	672	583
Other Central Texas	1,954	2,760	5,319	6,186	6,802
Total Central Texas	8,526	9,432	12,415	12,724	12,445
North Texas [6 7]	49,932	50,159	53,272	54,255	57,204
Panhandle [8]	30,881	33,295	33,435	31,726	29,716
South Texas [9]	23,681	29,285	41,498	48,423	54,245

See footnotes at end of table.

Production of crude petroleum in Texas, 1942–46, by districts and fields—Con.

[Thousands of barrels]

District and field	1942	1943	1944	1945	1946 [1]
West Texas:					
Andrews	1,345	2,008	7,129	14,383	18,641
Crane-Upton	9,628	11,598	17,028	18,476	18,266
Crockett	919	1,187	1,469	2,020	3,794
Ector [10]	16,132	20,303	33,635	34,180	38,532
Fisher	572	475	434	324	318
Gaines-Yoakum	11,530	15,785	33,785	32,909	30,726
Garza	8	7	12	151	1,215
Glasscock-Howard-Mitchell	7,165	7,008	7,332	7,599	7,704
Pecos	9,808	12,288	16,785	17,238	17,457
Reagan	1,931	2,006	2,456	3,011	2,808
Slaughter	7,403	11,267	23,222	24,119	21,444
Ward	5,890	5,734	7,153	6,919	6,750
Winkler	8,690	8,921	9,712	13,787	22,410
Other West Texas	754	632	853	611	2,231
Total West Texas	81,775	99,219	161,005	175,727	192,296
Total Texas	483,097	594,343	746,699	754,710	760,505

[1] Subject to revision.
[2] Included with "Other Gulf Coast" in 1942 and 1943.
[3] Includes crude oil consumed on leases and net change in stocks held on leases for entire district.
[4] Joiner, Kilgore, Lathrop, and other pools in Cherokee, Gregg, Rusk, Smith, and Upshur Counties.
[5] Includes other fields in Falls, Freestone, Limestone, and Navarro Counties.
[6] Includes the fields in and between Wilbarger, Wichita, Clay, Montague, and Cooke Counties on the north and Runnels, Coleman, Brown, and Comanche Counties on the south.
[7] Includes crude oil consumed on leases and net change in stocks held on leases for East (exclusive of East Texas proper) Central, North, and South Texas.
[8] Carson, Gray, Hutchinson, Moore, and Wheeler Counties.
[9] Includes fields in Brooks, Duval, Hidalgo, Jim Hogg, Jim Wells, La Salle, Live Oak, McMullen, Starr, Webb, and Zapata Counties.
[10] Includes the part of Jordan pool in Crane County.

Texas field was partly offset by a gain of 2.4 million barrels from the Hawkins field.

Oil-well completions increased to 4,720 in 1946 from 4,036 in 1945, with much of the gain in drilling in the East and West Texas districts. Exploratory completions numbered 1,591 in 1946 and resulted in 247 oil discoveries and extensions to existing fields. Both totals are moderately above the 1945 experience. Gulf Coast, North Central, and West Texas lead other districts in the number of discoveries in both 1945 and 1946.

Moderately lower production was reported in most fields of the Gulf Coast district, including all the leading fields except Thompsons, which increased only 129,000 barrels. Other fields with greater output in 1946 included Fannette, Refugio, Livingston, and Saxet.

Oil-well completions increased from 1,013 in 1945 to 1,100 in 1946. The most active fields, with the number of oil wells drilled, were: Seeligson 76, Willamar 59, Tom O'Connor 58, Tijerina-Canales 47, Falls City 42, and Refugio, Bonnie View, and Agua Dulce 25 each. Most of the concentrated drilling was in the lower portion of the district, as activity declined in the Upper Gulf.

Of 375 exploratory wells drilled, 79 discovered new oil or condensate, or extended old fields. Numerous new productive formations were opened, but discoveries of new fields were fewer than in 1945. Many of the discoveries produced from the Frio sand. Perhaps the most significant revelation of 1946 drilling was evidence that several major fields in Nueces, Kleberg, and Jim Wells Counties may develop into a single tremendous field.

West Texas production continued the upward trend of recent years, gaining 9 percent over 1945 to 192,296,000 barrels. Although the two leading fields—Wasson and Slaughter—produced less oil in 1946, material gains in other fields were numerous, the largest being from Keystone, TXL, and Fullerton.

In 1946, 1,462 oil wells were completed, compared with 1,309 in 1945. Among many active fields, the following recorded the greatest number of new oil wells in 1946: Keystone 126, TXL 109, Fullerton 92, Sharon Ridge 86, Garza 81, Welsh 79, and Slaughter 69.

Of 224 wildcat wells drilled, 49 were classified as oil discoveries. Nineteen new fields and many new pay sands and extensions were opened. Of great interest from a geological standpoint were the discovery of oil in Pennsylvanian limestone in Coke County, development of Ellenburger limestone production in Kent County, and production for the first time of oil from Mississippian limestone. Active exploration revealed in 1946 an unusual quantity of new evidence offering promise of development of important new reserves of oil and gas in the West Texas district.

Production from the East Texas district in 1946—171,497,000 barrels—was 7.4 million barrels less than in 1945 owing to the decline of 10.1 million barrels from the East Texas field, whose output of 121,080,000 barrels was the lowest since 1931. In that year its development and production were increasing rapidly toward the peak of flush production. Hawkins field production increased 2.4 million barrels to a new high of 14,843,000 barrels, and the old Talco field gained 500,000 barrels after several years of decline. Persistent declines continued at Cayuga, Rodessa, and Sulphur Bluff.

Oil-well completions increased sharply over 1945 to 385, owing chiefly to the completion of 145 wells at Hawkins. Oil completions in other active fields were: East Texas 28, Talco 23, Smithland 19, Sand Flat 16, Merigale 15, and Pickton 14. One oil well was drilled in the Carthage gas and condensate field and 120 gas wells.

Exploration resulted in the discovery of 12 new fields—8 producing oil and 4 gas or condensate. The new oil fields were: North Gallatin (Woodbine sand) and William Wise (Woodbine) in Cherokee County, Norman Paul (Woodbine and Eagle Ford) in Wood County, Boynton (Paluxy) and Mt. Sylvan (Paluxy) in Smith County, Elysian Fields (Travis Peak) in Harrison County, Lassater (Travis Peak) in Marion County, and South Flynn (Woodbine-Eagle Ford) in Leon County. The gas fields were found in Rusk (two), Bowie, and Shelby Counties.

Central Texas production declined slightly in 1946 as output of the principal old fields contracted. The North Texas district continued the expansion of recent years, increasing its output almost 6 percent over 1945. Drilling was more active in 1946, with the trend of exploratory drilling to the west flank of the Bend Arch with deeper objectives. Discoveries were most numerous in Archer, Wilbarger, Jones, Young, Montague, and Cook Counties. Discoveries in Stephens (Caddo lime), Throckmorton, Haskell (Strawn), and Fisher (Canyon) Counties were considered important.

Panhandle production decreased 2 million barrels in 1946 to 29,716,000 barrels, coincident with a continued contraction in drilling for oil. New oil wells numbered 149 compared with 176 in 1945. All

wildcat wells, of which there were five in 1946, were dry holes, as in 1945. Exploratory activity in the northeastern (Anadarko Basin) section of the Panhandle has increased, influenced by developments in Oklahoma.

Virginia.—Crude petroleum was first produced in Virginia in the summer of 1942, when two small discovery wells were completed in Lee County. A third producing well was drilled in 1945. These wells, together with all holdings of the original company, were taken over by a new operator in 1946, and six new test wells were drilled before the end of the year. All of these wells were reported to be in the area of the original Rose Hill field, which is a small window in the Cumberland overthrust block.

Crude production amounted to 2,000 barrels in 1943, 3,000 barrels in 1944, 4,000 barrels in 1945, and 16,000 barrels in 1946.

West Virginia.—Crude petroleum production in 1946, amounting to 2,929,000 barrels, was 50,000 barrels above the 1945 total but 18 percent below that of 1942.

According to a report of David B. Reger, Morgantown, W. Va., oil-well completions were 87 in 1946 compared with 80 in 1945. Only 2 of the 33 wildcat wells were recorded as oil wells, and these were not important enough to add to the total oil reserves of the State. The most active counties and the number of new oil wells in each were: Calhoun 18, Ritchie 15, Wood 10, Kanawha 9, Pleasants 7, Roane 6, and Wirt 6.

Since the total number of oil wells abandoned in 1946 was larger than the total of oil-well completions, the list of operating wells at the end of 1946 was smaller than at the close of 1945.

Production of crude petroleum in West Virginia, 1942–46, by months

[Thousands of barrels]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1942	294	267	310	313	297	306	306	305	310	321	267	278	3,574
1943	296	261	295	285	272	298	281	278	274	278	264	267	3,349
1944	259	254	270	249	280	258	224	293	252	264	248	219	3,070
1945	251	218	261	236	246	238	242	264	223	244	236	220	2,879
1946 [1]	254	225	250	256	259	259	208	274	235	258	225	226	2,929

[1] Subject to revision.

Wyoming.—Production of crude petroleum increased further in 1946 to 38,304,000 barrels, a gain of 2.1 million barrels over 1945. The principal gains were at Elk Basin, Steamboat Butte, and Hamilton Dome. The last field obtained a pipeline outlet for the first time in 1946 after many years of developed production. The gradual upward trend in Wyoming production since 1933 has been strongly influenced by pipe-line construction, for many of its fields have remained shut in for extended periods for lack of a market. Beginning in 1935, when the line from Casper, Wyo., to Freeman, Mo., was returned to oil use from natural gas, facilities for marketing crude outside of the State have gradually increased. Pipe lines were laid successively to Denver, Colo., Salt Lake City, Utah, and Billings, Mont. The current high demand for petroleum and its products is encouraging the consideration of projects for increasing the transportation facilities to major market points and for improving the network of lines within the State to serve adequately its productive areas.

Oil-well completions declined from 162 in 1945 to 109 in 1946, as drilling in all the most active fields in 1945 declined materially. Oil completions in the most active fields in 1946 were: Big Muddy 8, Frannie 7, and Gebo and Oregon Basin 6.

Thirteen oil discoveries were made by the 54 exploratory wells drilled. Of these five were new fields, four new productive zones, and four field extensions. Apparently the most important of the new fields were: River Dome in Washakie County (Embar), Dubois in Fremont County (Embar), and Church Buttes in Uinta County (condensate and gas from Dakota). Production was opened at Elk Basin from the Madison and Dakota (gas) formation, at Black Mountain from the Madison, and at Bailey from Tensleep sand.

Extensions were reported to the following fields: Beaver Creek, Crooks Gap, Zimmerman Butte, and Big Muddy.

Production of crude petroleum in Wyoming, 1942–46, by fields

[Thousands of barrels]

Year	Big Muddy	Byron-Garland	Cole Creek	Elk Basin	Frannie	Grass Creek	Hamilton Dome	La Barge	Lance Creek	Lost Soldier-Ferris-Wertz
1942	402	2,163	372	156	1,013	1,524	445	767	7,857	5,118
1943	382	2,554	414	2,133	846	1,313	508	655	7,082	4,246
1944	504	2,534	514	2,885	1,092	993	470	585	6,535	3,441
1945	549	3,752	563	3,190	1,487	1,016	957	510	5,503	3,135
1946 [1]	568	3,814	499	4,580	1,331	1,094	1,346	461	4,920	3,183

Year	Maverick Springs	Oregon Basin	Pilot Butte	Poison Spider-South Casper	Rock Creek	Salt Creek	Steamboat Butte	Winkleman	Other fields [2]	Total
1942	750	4,711	175	236	933	5,004	----	----	1,186	32,812
1943	566	5,345	464	262	911	4,820	219	----	1,533	34,253
1944	474	4,388	370	229	935	4,802	601	117	1,887	33,356
1945	324	4,454	260	233	841	4,578	1,017	228	3,622	36,219
1946 [1]	254	4,164	325	274	853	4,642	1,888	385	3,723	38,304

[1] Subject to revision.
[2] Includes crude oil consumed on leases and net change in stocks held on leases for entire State.

WELLS

The number of wells drilled in the United States, including oil and gas wells and dry holes, increased from 24,667 in 1945 to 26,991 in 1946. This represents a 9-percent increase in 1946 compared with a 7-percent increase in 1945.

Oil-well completions rose 11 percent from 14,297 in 1945 to 15,851 in 1946, dry holes increased from 7,471 in 1945 to 8,050 in 1946, and the number of gas wells increased from 2,899 in 1945 to 3,090 in 1946. The number of oil wells completed in 1946 represented 58.7 percent of the total wells drilled compared with 58.0 percent in 1945. Dry holes constituted 29.8 percent of the total wells drilled in 1946 compared with 30.3 percent in 1945. Gas wells completed were 11.5 percent of the total wells drilled in 1946 and 11.7 percent in 1945.

Wells drilled for oil and gas in the United States, 1945–46, by months

[Oil and Gas Journal]

Wells	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
													Number	Percent
1945														
Oil	1,022	1,024	1,235	1,151	1,146	1,350	1,240	1,158	1,389	1,089	1,156	1,337	14,297	58.0
Gas	214	226	260	224	211	261	251	226	292	214	262	258	2,899	11.7
Dry	517	535	590	583	556	756	627	626	751	598	648	684	7,471	30.3
Total	1,753	1,785	2,085	1,958	1,913	2,367	2,118	2,010	2,432	1,901	2,066	2,279	24,667	100.0
1946														
Oil	1,254	1,145	1,375	1,270	1,314	1,418	1,257	1,442	1,362	1,442	1,324	1,248	15,851	58.7
Gas	199	222	250	198	242	244	272	291	289	331	306	246	3,090	11.5
Dry	588	464	672	559	671	746	660	735	695	764	768	728	8,050	29.8
Total	2,041	1,831	2,297	2,027	2,227	2,408	2,189	2,468	2,346	2,537	2,398	2,222	26,991	100.0
1946—service wells not included above)	152	159	184	243	197	182	196	196	189	174	189	176	2,237	------

The total number of oil wells completed in Texas rose from 4,036 in 1945 to 4,720 in 1946. In California the number of oil wells completed declined from 1,690 in 1945 to 1,375 in 1946. The number of oil wells completed in Louisiana rose from 646 in 1945 to 813 in 1946.

The total number of producing oil wells in the United States on December 31, 1944, was 412,220, and the number rose to 415,750 on December 31, 1945.

Wells drilled for oil and gas in the United States, 1945–46, by States and districts

[Oil and Gas Journal]

State and district	1945				1946			
	Oil	Gas	Dry	Total	Oil	Gas	Dry	Total
Alabama	13	1	23	37	3	-------	13	16
Arkansas	115	-------	70	185	110	2	71	183
California	1,690	56	404	2,150	1,375	65	350	1,790
Colorado	42	1	17	60	148	1	18	167
Illinois	1,060	1	688	1,749	1,344	6	991	2,341
Indiana	111	28	166	305	330	25	227	582
Kansas	838	201	745	1,784	1,055	300	657	2,012
Kentucky	382	108	247	737	299	139	275	713
Louisiana:								
Gulf Coast	407	19	189	615	363	13	208	584
Northern	239	89	165	493	450	102	247	799
Total Louisiana	646	108	354	1,108	813	115	455	1,383
Michigan	260	54	454	768	234	107	441	782
Mississippi	198	-------	164	362	154	6	100	260
Montana	217	38	57	312	159	71	83	313
Nebraska, Missouri, and Iowa	1	4	27	32	3	-------	15	18
New Mexico	279	21	124	424	294	42	75	411
Oklahoma	1,426	250	833	2,509	1,654	341	1,001	2,996
Pennsylvania, New York, Ohio, and West Virginia	2,820	1,303	587	4,710	3,044	1,357	602	5,003
Texas:								
Gulf Coast	1,013	150	558	1,721	1,100	137	482	1,719
East Texas	157	115	125	397	385	149	153	687
West Texas	1,309	26	405	1,740	1,462	18	300	1,780
Other districts	1,557	423	1,346	3,326	1,773	195	1,647	3,615
Total Texas	4,036	714	2,434	7,184	4,720	499	2,582	7,801
Wyoming	162	10	55	227	109	11	48	168
Other States	1	1	22	24	3	3	46	52
Total United States	14,297	2,899	7,471	24,667	15,851	3,090	8,050	26,991

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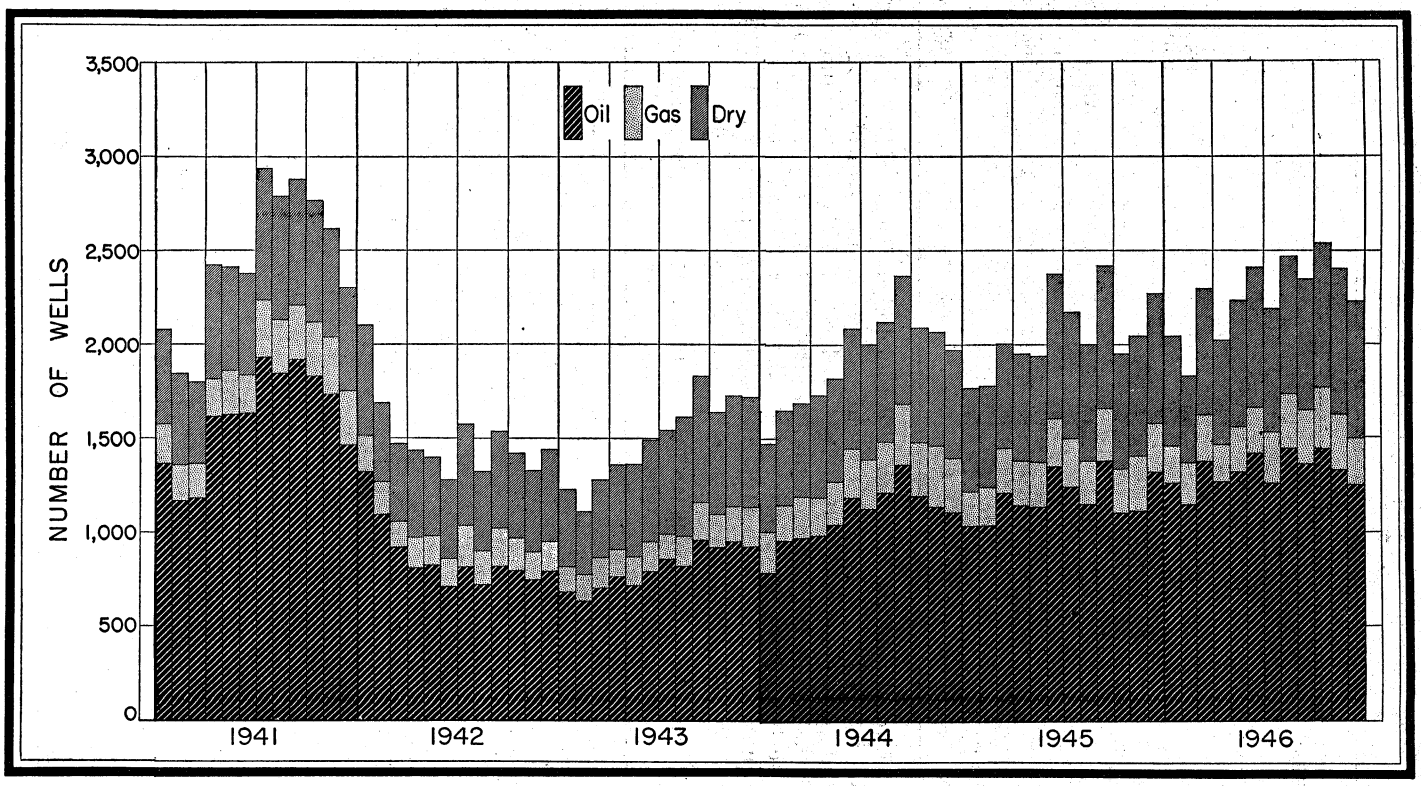

FIGURE 4.—Wells drilled in the United States 1941–46, by months.

Producing oil wells in the United States and average production per day in 1945, by States and districts [1]

State and district	Producing oil wells		State and district	Producing oil wells	
	Approximate number, Dec. 31	Average production per well per day (barrels)		Approximate number, Dec. 31	Average production per well per day (barrels)
Arkansas	3,240	24.2	New York	23,000	0.6
California	22,220	40.9	Ohio	20,500	.4
Colorado	290	53.1	Oklahoma	52,000	7.3
Illinois	24,600	8.4	Pennsylvania	83,100	.4
Indiana	2,030	6.5			
Kansas	25,500	10.5	Texas:		
Kentucky	15,000	1.8	Gulf Coast	14,100	49.3
			East Texas proper	24,000	14.7
Louisiana:			West Texas	18,000	27.5
Gulf Coast	3,450	86.4	Other districts	48,300	11.3
Northern	4,200	15.6			
			Total Texas	104,400	20.0
Total Louisiana	7,650	47.5	West Virginia	16,660	.5
Michigan	3,550	13.6	Wyoming	4,120	24.7
Mississippi	650	93.3	Other States [2]	120	6.4
Montana	2,600	9.6			
Nebraska	70	11.1	Total United States	415,750	11.3
New Mexico	4,450	23.5			

[1] Figures for 1946 not yet available.
[2] Alabama, Florida, Missouri, Tennessee, and Virginia.

CONSUMPTION AND DISTRIBUTION

The total demand for crude petroleum amounted to 1,813 million barrels in 1946 compared with 1,792 million in 1945 and 1,472 million in 1941. Imported crude oil included in this demand amounted to 4.1 percent of the total in 1945 and 4.7 percent in 1946. About 95.4 percent of the crude oil consumed in 1946 was delivered for refining in the United States, and the remaining 4.6 percent represented crude oil exported, used for fuel, or lost.

Runs to Stills.—Total crude runs to stills amounted to 1,730 million barrels in 1946—a gain of 10 million barrels compared with 1945. Runs of foreign crude amounted to 84 million barrels, and runs of domestic crude were 1,646 million. The principal increases in crude runs, by refinery districts, were 22 million barrels in the Louisiana Gulf Coast and 21 million in the Texas Gulf Coast. The major decreases in crude runs were almost 29 million barrels in California, 6 million in the Arkansas–Louisiana Inland, and 6 million in the Texas Inland district.

Distribution.—The total demand for domestic crude petroleum rose from 1,718 million barrels in 1945 to a new record of 1,728 million in 1946—a gain of 10 million barrels. The demand was met by a crude production of 1,733 million barrels, of which 5 million barrels were added to stocks. The supply of domestic crude petroleum was supplemented by a gain in the imports of foreign crude oil from 74 million barrels in 1945 to 86 million in 1946. Imports of refined oils increased from 39 million barrels in 1945 to 49 million in 1946. Total stocks of refined oils increased 36 million barrels during the year compared with withdrawals of 10 million barrels in 1945.

Runs to stills of crude petroleum in the United States in 1946, by districts and months

[Thousands of barrels]

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
East Coast:													
Domestic	15,995	15,224	17,114	15,238	16,871	16,449	16,261	16,332	15,818	15,780	15,126	16,182	192,390
Foreign	6,806	6,687	6,704	7,176	7,402	6,409	7,411	6,845	7,666	6,997	6,997	7,161	84,261
Total East Coast	22,801	21,911	23,818	22,414	24,273	22,858	23,672	23,177	23,484	22,777	22,123	23,343	276,651
Appalachian	4,620	4,285	4,654	4,586	4,800	4,457	4,351	5,057	4,527	4,697	4,762	4,960	55,756
Indiana, Illinois, Kentucky, etc	21,835	20,235	22,392	22,795	24,407	23,093	24,720	24,729	23,976	24,541	23,377	23,710	279,810
Oklahoma, Kansas, Missouri, etc	11,441	10,457	11,519	10,982	11,951	11,840	12,178	12,111	11,450	11,323	11,246	11,887	138,385
Texas Inland	6,422	5,544	6,322	6,266	6,737	6,742	7,040	7,080	6,572	6,794	6,604	6,689	78,812
Texas Gulf Coast:													
Domestic	34,317	32,827	35,923	33,987	35,948	36,402	37,795	36,878	35,075	35,871	33,259	36,246	424,528
Foreign							91						91
Total Texas Gulf Coast	34,317	32,827	35,923	33,987	35,948	36,042	37,886	36,878	35,075	35,871	33,259	36,246	424,619
Louisiana Gulf Coast:													
Domestic	9,085	8,641	9,716	9,910	9,916	10,278	10,593	10,842	10,328	10,887	10,371	10,648	121,215
Foreign													
Total Louisiana Gulf Coast	9,085	8,641	9,716	9,910	9,916	10,278	10,593	10,842	10,328	10,887	10,371	10,648	121,215
Arkansas-Louisiana Inland	1,808	1,596	1,787	1,775	1,853	1,833	1,827	2,005	1,829	1,906	1,815	1,933	21,967
Rocky Mountain	3,894	3,240	4,185	3,634	4,154	4,218	3,950	4,297	4,240	4,072	3,953	4,207	48,044
California	23,907	21,496	24,172	23,535	24,582	23,348	24,324	24,374	23,700	23,948	23,004	24,548	284,938
Total domestic	133,324	123,545	137,784	132,708	141,219	138,660	143,039	143,705	137,515	139,819	133,517	141,010	1,645,845
Total foreign	6,806	6,687	6,704	7,176	7,402	6,409	7,502	6,845	7,666	6,997	6,997	7,161	84,352
Total 1946 (final figures)	140,130	130,232	144,488	139,884	148,621	145,069	150,541	150,550	145,181	146,816	140,514	148,171	1,730,197
Total 1945 (final figures)	145,071	134,882	146,285	143,221	152,295	149,682	155,040	152,771	128,236	131,567	138,705	141,779	1,719,534
Daily average 1946 (final figures)	4,520	4,651	4,661	4,663	4,794	4,836	4,856	4,856	4,839	4,736	4,684	4,780	4,740

Receipts of domestic and foreign crude petroleum at United States refineries totaled 1,737 million barrels in 1946 compared with 1,724 million in 1945. In 1946 receipts of foreign crude petroleum were 86 million barrels, or 4.9 percent of the total; interstate receipts of domestic crude were 645 million, or 37.2 percent of the total; and intrastate receipts were 1,006 million, or 57.9 percent of the total.

Demand for crude petroleum in the United States, 1943–46, by States of origin

[Thousands of barrels]

State	1943		1944		1945		1946[1]	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
Alabama			33	0.1	151	0.4	382	1.0
Arkansas	27,143	74.4	29,226	79.9	29,272	80.2	28,068	76.9
California	288,363	790.0	322,473	881.1	329,473	902.7	310,560	850.9
Colorado	2,431	6.7	3,092	8.4	4,815	13.2	11,115	30.5
Illinois	78,396	214.8	77,307	211.2	72,907	199.7	75,851	207.8
Indiana	5,340	14.6	5,027	13.7	4,955	13.6	6,776	18.6
Kansas	105,715	289.7	98,134	268.1	95,609	261.9	96,743	265.1
Kentucky	7,775	21.3	9,598	26.2	10,247	28.1	10,399	28.5
Louisiana	121,085	331.7	130,819	357.4	131,518	360.3	144,684	396.4
Michigan	20,699	56.7	18,573	50.7	17,210	47.2	16,977	46.5
Mississippi	19,638	53.8	16,261	44.4	17,814	48.8	23,744	65.1
Montana	7,634	20.9	8,862	24.2	8,241	22.6	9,051	24.8
Nebraska	613	1.7	427	1.2	316	.9	272	.7
New Mexico	37,599	103.0	40,062	109.5	37,978	104.0	36,546	100.1
New York	5,138	14.1	4,726	12.9	4,666	12.8	4,860	13.3
Ohio	3,260	8.9	3,020	8.2	2,819	7.7	2,751	7.5
Oklahoma	130,384	357.2	125,533	343.0	135,318	370.7	139,581	382.4
Pennsylvania	16,048	44.0	14,382	39.3	12,487	34.2	12,724	34.9
Texas	583,113	1,597.6	752,849	2,057.0	762,576	2,089.3	757,501	2,075.3
West Virginia	3,591	9.8	3,101	8.5	2,930	8.0	2,875	7.9
Wyoming	36,690	100.5	37,901	103.6	36,247	99.3	36,006	98.6
Other States	48	.1	55	.2	101	.3	121	.3
Total United States	1,500,703	4,111.5	1,701,461	4,648.8	1,717,650	4,705.9	1,727,587	4,733.1

[1] Subject to revision.

Refinery receipts of crude petroleum in 1946, by methods of transportation, indicated that 74.3 percent of the total was delivered by pipe lines, compared with 79.4 percent in 1945; that 23.5 percent was delivered by boat, compared with 16.3 percent in 1945; and that 2.2 percent was delivered by tank car and truck, compared with 4.3 percent in 1945. The relative decline in pipe-line and tank-car movements and the increase in boat deliveries reflect the elimination of abnormal wartime movements and the resumption of the tanker movements from Gulf to East Coast ports.

The principal changes in the market demand for crude petroleum by States of origin (computed from production and changes in crude stocks by origin) in 1946 compared with 1945 were gains of 13 million barrels for Louisiana, 6 million for Colorado, 6 million for Mississippi, 4 million for Oklahoma, and 3 million for Illinois. Principal decreases were 19 million barrels for California and 5 million for Texas. Fourteen States had a market demand for crude exceeding 10 million barrels and contributed over 98 percent of the total demand for domestic crude.

Receipts of crude petroleum at refineries in the United States, 1942–46, by methods of transportation

[Millions of barrels]

Method of transportation	1942	1943	1944	1945	1946 [1]
By boat:					
Intrastate	45.2	54.4	63.2	94.1	96.7
Interstate	74.3	35.2	57.1	113.3	226.2
Foreign	12.2	13.8	44.8	74.3	86.1
Total by boat	131.7	103.4	165.1	281.7	409.0
By pipe lines:					
Intrastate	731.2	788.8	909.6	913.6	888.9
Interstate	330.5	390.1	480.8	454.3	401.4
Total by pipe lines	1,061.7	1,178.9	1,390.4	1,367.9	1,290.3
By tank car and truck:					
Intrastate	18.0	15.7	16.5	15.2	20.1
Interstate	116.3	138.2	96.5	59.1	17.8
Total by tank car and truck	134.3	153.9	113.0	74.3	37.9
Grand total	1,327.7	1,436.2	1,668.5	1,723.9	1,737.2

[1] Subject to revision.

The total demand for Texas crude oil declined from 763 million barrels in 1945 to 758 million in 1946. The record production during the year amounted to 761 million barrels—a gain of 6 million compared with 1946; however, 3 million barrels were added to crude stocks of Texas origin compared with withdrawals of 8 million barrels in 1945. The relative contribution of Texas to the national demand for domestic crude oil declined from 44.4 percent in 1945 to 43.8 percent in 1946. About 58 percent of the deliveries of Texas crude oil to refineries went to plants located within the State, and 43 percent was delivered to refineries in other States. About 168 million barrels were delivered to refineries in the East Coast district in 1946—representing 60 percent of the total receipts of foreign and domestic crude in that district. The largest shipments to other refinery districts were 93 million barrels to the Indiana-Illinois district, 36 million to the Louisiana Gulf, and 21 million to the Oklahoma-Kansas district.

California ranked second as a source of crude oil supply in the United States—supplying 18.0 percent of the total demand for domestic crude oil in 1946 compared with 19.2 percent in 1945. Production was 11 million barrels less than in 1945, and almost 5 million barrels were added to stocks compared with a withdrawal of 3 million barrels in 1945. Total demand in 1946 amounted to almost 311 million barrels, of which about 284 million barrels were run to stills by refineries within the State, 5 million were exported, and 22 million barrels represented crude used direct for fuel plus losses.

Louisiana was the third largest source of crude-oil supply in 1946. The demand for Louisiana crude oil has continued to increase in recent years and gained 13 million barrels in 1946. The percentage of the total demand for domestic crude rose from 7.7 in 1945 to 8.4 in 1946. Demand in 1946 amounted to almost 145 million barrels and included a reduction in stocks of over 1 million barrels. Over half of the total went to refineries within the State. The principal deliveries outside the State went to the Texas Gulf and East Coast refinery districts.

Daily average demand for domestic crude petroleum in the United States in 1945–46, by States of origin and by months

[Thousands of barrels]

State	January	February	March	April	May	June	July	August	September	October	November	December	Year
1945													
Alabama	0.1	0.2	0.2	0.5	0.4	0.8	0.4	0.1	0.4	0.3	1.4	0.3	0.4
Arkansas	86.1	84.8	81.7	82.8	77.7	78.1	84.5	72.2	88.4	76.4	72.3	77.7	80.2
California	889.8	908.4	901.6	919.7	986.1	986.0	961.4	948.1	872.0	821.9	817.8	819.3	902.7
Colorado	10.4	10.1	10.4	8.5	9.1	11.7	14.4	12.9	13.4	21.1	17.2	18.7	13.2
Florida	.1	.2	.2	.2			.1	.1	.2	.1	.1	.1	.1
Illinois	202.0	212.2	209.1	209.9	226.9	204.7	214.9	228.3	138.2	163.8	216.9	170.3	199.7
Indiana	15.6	15.6	13.6	10.3	13.7	14.2	15.2	13.7	12.1	14.1	11.2	13.6	13.6
Kansas	258.4	275.7	257.1	255.8	290.3	268.3	261.5	260.4	265.8	236.2	264.1	251.3	261.9
Kentucky	27.7	34.1	21.2	32.0	27.7	27.1	28.2	28.3	26.3	29.3	31.2	24.6	28.1
Louisiana	345.2	379.9	354.5	348.0	329.4	375.9	387.1	376.8	336.7	336.6	382.5	373.2	360.3
Michigan	50.0	49.9	46.4	46.9	47.7	46.1	49.9	47.3	43.9	47.8	45.7	44.4	47.2
Mississippi	41.0	49.4	47.4	55.3	62.3	54.3	35.3	57.4	42.6	25.0	58.4	57.9	48.8
Montana	22.2	24.7	22.4	17.5	26.5	24.1	19.7	29.9	19.4	19.4	23.2	22.0	22.6
Nebraska	.6	1.6	.7	.9	.9	.7	1.1	.8	.7	1.0	.8	.7	.9
New Mexico	101.9	104.5	102.4	118.3	102.1	112.6	120.0	95.4	94.8	91.9	110.1	95.2	104.0
New York	12.1	11.8	12.4	12.7	12.2	14.6	10.8	15.3	12.9	11.7	14.9	12.2	12.8
Ohio	7.5	2.7	8.5	11.8	6.6	6.7	9.1	6.3	9.1	7.8	8.3	7.9	7.7
Oklahoma	379.8	362.9	362.1	363.8	361.0	373.3	384.5	396.3	348.1	399.8	342.5	372.0	370.7
Pennsylvania	32.3	33.3	33.9	35.7	34.3	35.5	35.3	36.4	34.5	30.9	35.0	33.4	34.2
Texas	2,100.8	2,172.7	2,106.0	2,156.9	2,242.7	2,247.1	2,226.8	2,202.9	1,780.0	1,786.2	2,043.1	2,009.6	2,089.3
West Virginia	7.1	6.9	8.5	8.1	7.8	8.7	9.8	6.6	7.1	8.4	9.3	8.0	8.0
Wyoming	113.4	88.0	114.1	103.4	94.2	118.4	109.9	96.5	96.5	90.5	81.8	83.9	99.3
Missouri, Tennessee, and Virginia	.1	.1	.2	.2	.2	.2	.2	.2	.1	.2	.2	.1	.2
Total 1945	4,704.2	4,829.7	4,714.6	4,799.2	4,959.8	5,009.1	4,980.1	4,932.2	4,243.2	4,220.4	4,588.0	4,496.4	4,705.9
1946 [1]													
Alabama	.2	.7	1.1	2.1	.8	.8	1.5	.9	1.5	.6	.8	1.6	1.0
Arkansas	69.3	82.5	73.4	80.3	77.4	77.2	76.3	77.2	76.0	75.8	79.5	78.8	76.9
California	819.3	821.3	855.3	847.3	867.4	857.8	861.6	857.3	860.2	854.0	851.2	854.9	850.9
Colorado	23.4	27.2	10.8	30.4	23.7	34.6	26.4	32.5	38.3	48.2	31.9	38.1	30.5
Florida		.1	.2	.1		.2	.2	.2			.2	.1	.1
Illinois	167.2	212.5	132.3	216.9	242.3	186.9	230.6	228.9	231.9	231.2	194.5	219.0	207.8
Indiana	16.2	17.6	20.2	21.2	19.9	19.0	19.2	18.2	16.1	18.9	14.1	21.9	18.6
Kansas	240.6	282.5	250.1	256.8	251.9	265.5	288.7	274.3	291.9	264.2	271.2	245.4	265.1
Kentucky	30.0	29.6	24.4	25.2	29.0	32.7	25.3	28.3	31.1	25.5	29.3	31.7	28.5

See footnote at end of table.

Daily average demand for domestic crude petroleum in the United States in 1945–46, by States of origin and by months—Continued

[Thousands of barrels]

State	January	February	March	April	May	June	July	August	September	October	November	December	Year
1946 [1]—Continued													
Louisiana	411.4	398.9	366.4	404.0	402.2	368.2	401.2	389.2	411.0	421.6	384.6	397.5	396.4
Michigan	47.5	44.7	42.3	51.2	45.3	49.9	45.1	41.5	49.4	45.4	46.9	49.0	46.5
Mississippi	55.0	62.6	47.9	58.3	53.9	74.5	51.1	63.9	82.9	69.1	80.0	82.3	65.1
Montana	22.9	23.5	27.4	18.2	29.5	23.3	24.9	26.6	27.6	21.2	27.0	25.2	24.8
Nebraska	.8	.8	.7	.8	.9	.8	.8	.8	.7	.6	.6	.6	.7
New Mexico	97.3	65.2	113.3	101.8	103.5	109.9	102.0	89.9	124.5	89.8	94.4	107.5	100.1
New York	13.3	13.3	13.3	13.6	13.1	12.8	12.8	14.1	14.0	13.6	13.2	12.7	13.3
Ohio	6.2	8.3	7.0	6.2	8.3	7.6	7.9	8.2	7.0	7.7	7.7	8.3	7.5
Oklahoma	364.8	347.2	430.8	396.7	393.7	399.2	355.2	407.1	360.1	382.0	350.4	397.6	382.4
Pennsylvania	34.7	32.1	33.6	33.9	33.0	36.7	35.5	36.2	32.9	36.8	36.4	36.4	34.9
Texas	1,957.7	2,017.3	2,035.3	1,975.0	2,084.8	2,193.8	2,192.4	2,184.9	2,058.1	2,080.1	2,062.8	2,056.0	2,075.3
West Virginia	6.1	9.0	7.4	6.6	9.4	6.6	8.6	5.5	10.2	9.9	6.3	8.9	7.9
Wyoming	91.2	83.0	114.8	94.8	106.3	101.8	96.1	99.8	105.8	93.1	96.9	99.0	98.6
Missouri, Tennessee, and Virginia	.2	.3	.2	.2	.2	.2	.2	.2	.2	.2	.2	.5	.2
Total 1946	4,475.3	4,580.2	4,608.2	4,641.6	4,796.5	4,860.0	4,863.6	4,885.7	4,831.4	4,789.5	4,680.1	4,773.0	4,733.1

[1] Subject to revision.

Demand for domestic crude petroleum in the United States, 1945–46, by States of origin and by months

[Thousands of barrels]

State	January	February	March	April	May	June	July	August	September	October	November	December	Year
1945													
Alabama	4	5	5	16	11	24	12	2	12	9	43	8	151
Arkansas	2,669	2,375	2,532	2,485	2,410	2,344	2,619	2,237	2,653	2,369	2,169	2,410	29,272
California	27,584	25,436	27,948	27,591	30,568	29,581	29,805	29,391	26,159	25,479	24,533	25,398	329,473
Colorado	321	283	323	256	282	352	446	400	401	655	517	579	4,815
Florida	4	6	5	5	----	1	3	3	6	4	2	3	42
Illinois	6,262	5,942	6,483	6,297	7,033	6,141	6,662	7,078	4,145	5,078	6,506	5,280	72,907
Indiana	484	436	421	309	425	425	472	425	364	438	336	420	4,955
Kansas	8,011	7,719	7,970	7,675	8,998	8,050	8,106	8,073	7,973	7,323	7,922	7,789	95,609
Kentucky	857	955	957	960	860	813	873	876	790	907	935	764	10,247
Louisiana	10,701	10,638	10,990	10,441	10,211	11,276	12,002	11,680	10,101	10,434	11,474	11,570	131,518
Michigan	1,550	1,397	1,438	1,406	1,480	1,382	1,548	1,465	1,316	1,483	1,370	1,375	17,210
Mississippi	1,271	1,384	1,469	1,658	1,930	1,630	1,094	1,780	1,278	774	1,752	1,794	17,814
Montana	689	691	694	524	821	724	610	927	582	601	695	683	8,241
Nebraska	19	43	21	26	29	21	33	26	22	31	24	21	316
New Mexico	3,160	2,926	3,176	3,548	3,165	3,377	3,720	2,957	2,844	2,850	3,303	2,952	37,978
New York	374	330	384	381	378	436	336	474	386	361	447	379	4,666
Ohio	232	74	265	355	205	200	282	196	274	240	250	246	2,819
Oklahoma	11,773	10,161	11,227	10,915	11,192	11,200	11,919	12,284	10,444	12,395	10,276	11,532	135,318
Pennsylvania	1,002	933	1,052	1,071	1,064	1,064	1,094	1,129	1,034	958	1,051	1,035	12,487
Texas	65,123	60,836	65,286	64,708	69,525	67,414	69,030	68,291	53,401	55,372	61,294	62,296	762,576
West Virginia	221	193	264	243	241	261	304	205	212	259	279	248	2,930
Wyoming	3,514	2,464	3,536	3,101	2,921	3,553	3,408	2,993	2,896	2,805	2,455	2,601	36,247
Other States	4	4	6	5	5	5	5	5	4	6	6	4	[1] 59
Total 1945	145,829	135,231	146,152	143,976	153,754	150,274	154,383	152,897	127,297	130,831	137,639	139,387	1,717,650
Daily average	4,704	4,830	4,715	4,799	4,960	5,009	4,980	4,932	4,243	4,220	4,588	4,496	4,706
1946 [2]													
Alabama	7	18	34	63	25	25	45	27	47	18	23	50	382
Arkansas	2,147	2,310	2,275	2,409	2,400	2,315	2,365	2,393	2,279	2,348	2,385	2,442	28,068
California	25,397	22,997	26,516	25,418	26,889	25,735	26,711	26,578	25,807	26,475	25,536	26,501	31,560
Colorado	726	760	336	912	735	1,038	818	1,007	1,150	1,493	957	1,183	11,115
Florida	1	4	5	3	2	7	6	6	1	----	5	4	44
Illinois	5,183	5,951	4,102	6,508	7,512	5,607	7,147	7,095	6,956	7,167	5,834	6,789	75,851
Indiana	502	494	625	635	616	569	596	566	484	585	424	680	6,776

See footnotes at end of table.

Demand for domestic crude petroleum in the United States, 1945–46, by States of origin and by months—Continued

[Thousands of barrels]

State	January	February	March	April	May	June	July	August	September	October	November	December	Year
1946 [2]—Continued													
Kansas	7,460	7,909	7,754	7,706	7,811	7,964	8,948	8,502	8,756	8,191	8,135	7,607	96,743
Kentucky	930	830	757	756	900	980	785	878	933	790	878	982	10,399
Louisiana	12,755	11,170	11,360	12,120	12,469	11,045	12,438	12,067	12,330	13,070	11,537	12,323	144,684
Michigan	1,472	1,250	1,310	1,536	1,404	1,499	1,399	1,288	1,484	1,407	1,407	1,521	16,977
Mississippi	1,706	1,753	1,486	1,748	1,671	2,234	1,585	1,980	2,487	2,142	2,401	2,551	23,744
Montana	711	658	848	547	915	698	773	826	827	658	810	780	9,051
Nebraska	25	21	22	25	27	24	26	24	20	20	18	20	272
New Mexico	3,016	1,825	3,511	3,054	3,208	3,297	3,162	2,788	3,734	2,785	2,832	3,334	36,546
New York	412	373	413	407	405	384	397	437	420	422	396	394	4,860
Ohio	191	233	218	185	258	229	246	254	210	239	231	257	2,751
Oklahoma	11,310	9,722	13,354	11,900	12,204	11,976	11,012	12,620	10,803	11,843	10,512	12,325	139,581
Pennsylvania	1,075	899	1,041	1,016	1,023	1,102	1,100	1,121	988	1,142	1,090	1,127	12,724
Texas	60,688	56,484	63,093	59,251	64,630	65,815	67,963	67,731	61,743	64,483	61,885	63,735	757,501
West Virginia	190	251	230	199	290	198	267	172	305	307	190	276	2,875
Wyoming	2,826	2,325	3,559	2,844	3,294	3,054	2,977	3,092	3,172	2,885	2,909	3,069	36,006
Other States	5	8	6	5	5	5	5	5	5	6	9	13	[3] 77
Total 1946	138,735	128,245	142,855	139,247	148,693	145,800	150,771	151,457	144,941	148,476	140,404	147,963	1,727,587
Daily average	4,475	4,580	4,608	4,642	4,797	4,860	4,864	4,886	4,831	4,790	4,680	4,773	4,733

[1] Missouri (47), Tennessee (8), and Virginia (4).
[2] Subject to revision.
[3] Missouri (51), Tennessee (10), and Virginia (16).

Distribution of crude petroleum in the United States in 1946, by States [1]

[Thousands of barrels]

State	Production	Refinery receipts of domestic crude, by origin							Runs to stills	Transfers to fuel
		Illinois	Kansas	Louisiana	New Mexico	Oklahoma	Texas	Other		
Alabama	380									2
Arkansas	28,375							15,031	14,947	247
California and Washington	315,179							288,198	284,938	19,077
Colorado	12,016							4,602	4,676	64
Georgia, Delaware, and South Carolina [2]	57							9	3,516	
Illinois, Minnesota, and Wisconsin	75,297	22,884	16,135	659	4,217	21,691	29,348	4,507	100,114	526
Indiana	6,726	2,495	23,403	90		15,504	44,789	1,822	87,901	36
Kansas and Nebraska	97,483		43,550			8,798	8,165	631	61,106	303
Kentucky and Tennessee	10,588	2,223		581			356	14,876	17,934	34
Louisiana:										
Gulf	112,535			72,752			35,763	14,396	121,215	1,102
Inland	30,768			1,990			89	5,048	5,462	255
Maryland				1,189			11,857	1,135	18,204	
Massachusetts and Rhode Island				399			6,248	10	13,627	
Michigan	17,074	1,665				1,827	6,788	15,949	25,473	270
Mississippi	24,216								1,558	76
Missouri	51		794			1,158	8,082		9,996	49
Montana	8,801							11,116	11,376	12
New Jersey				3,984	1,171	2,072	53,155	7,699	98,303	
New Mexico	36,860				3,327		704		4,034	235
New York:										
East							8,562	1,866	14,167	
West	4,863	4,394	347			5,475		4,008	14,181	
Ohio:										
East	2,908	13,129	120			5,458		2,051	20,707	109
West		17,532	549	2,092		13,386	11,805	2,572	48,388	
Oklahoma	134,497		7,254			54,878	5,112		67,283	651
Pennsylvania:										
East				4,022	1,673	17	87,798		128,834	
West	12,996	613				1,792	1,928	12,303	16,603	4
Texas:										
Gulf	243,102			36,944	17,726	3,860	364,927	987	424,619	918
Inland	517,403				3,211	407	74,892		78,812	1,938
Utah								6,897	6,877	
West Virginia [3]	2,945	78		728		665	181	2,644	4,265	
Wyoming and Idaho	38,304							21,313	21,081	357
Total	1,733,424	65,013	92,152	125,430	31,325	136,988	760,549	439,670	1,730,197	26,265

[1] Subject to revision.

[2] Includes Florida.

[3] Includes Virginia.

Oklahoma ranked fourth as a source of domestic crude oil in 1946. Production declined about 5 million barrels but was supplemented by 5 million barrels withdrawn from storage compared with an addition of 4 million barrels to stocks in 1945. Total demand in 1946 amounted to 140 million barrels, of which 55 million were delivered to refineries within the State. The largest outside markets were in Illinois, Ohio, and Indiana.

The demand for Kansas crude oil has declined from 106 million barrels in 1943 to about 97 million barrels in 1946, but current production shows an upward trend. In 1946, about 44 million barrels of Kansas crude oil were delivered to refineries within the State. The principal outside markets are in Indiana, Illinois, and Oklahoma.

STOCKS

The stocks of all oils amounted to 507.1 million barrels on December 31, 1946. The increase of 43.5 million barrels during the year included a gain of 6.9 million barrels in total crude stocks and of 36.6 million barrels in stocks of other oils.

Stocks of refined products amounted to 271.9 million barrels on December 31—about 22 million barrels less than on December 31, 1941. The principal gains during 1946 were 23.8 million barrels in stocks of distillate fuel oil, 9.9 million barrels in stocks of residual fuel oil, and 6.7 million barrels in stocks of kerosine. Stocks of finished gasoline, including aviation-gasoline stocks, declined 4.8 million barrels.

Stocks of crude petroleum, natural gasoline, and refined products in the United States at end of year, 1942–46

[Thousands of barrels]

Product	1942	1943	1944	1945	1946 [1]
Crude petroleum (refinable):					
At refineries	43,620	47,719	48,576 [2] 48,377	50,276	53,113
Pipe line and tank farm	177,904	181,422	158,181	153,957	156,238
Producers	13,365	14,365 [2] 12,991	14,105	14,530	15,122
Total refinable	234,889	243,506 [2] 242,132	220,862 [2] 220,663	218,763	224,473
California heavy crude	10,865	8,289 [2] 7,272	6,107	4,496	5,703
Total crude petroleum	245,754	251,795 [2] 249,404	226,969 [2] 226,770	223,259	230,176
Natural gasoline	4,632	4,541	4,252 [2] 4,451	4,322	4,981
Refined products [3]	247,554	229,362	245,868	235,998	271,937
Grand total	497,940	485,698 [2] 483,307	477,089	463,579	507,094

[1] Final figures.
[2] New basis comparable with succeeding years.
[3] Includes equivalents for wax, coke, and asphalt in barrels.

Stocks of refined products were increased in 1946 to replace depleted stocks during the war period and to service increased civilian demand. The large addition to distillate fuel-oil stocks was directly related to the rising civilian demand with termination of rationing in 1945 and the rapid increase in the number of heating-oil installations.

Stocks of crude petroleum in the United States in 1946, by States of location and by months [1]

[Thousands of barrels]

State	Jan. 1	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
LOCATION													
Arkansas	1,761	1,904	1,869	1,874	1,927	1,876	1,923	1,873	1,842	1,929	1,879	2,047	1,995
California and Washington	18,720	19,253	19,969	19,977	20,449	20,028	20,354	20,689	20,888	20,727	21,007	21,721	22,143
Colorado	583	597	497	505	570	738	730	697	736	704	664	651	612
Georgia, Florida, South Carolina, and Virginia	163	406	274	320	314	329	357	312	128	145	181	160	326
Illinois, Minnesota, and Wisconsin	16,066	17,141	17,298	17,811	16,868	16,227	16,394	15,987	15,895	15,619	15,219	15,643	15,958
Indiana	4,214	4,351	4,334	4,192	4,350	3,912	3,934	4,000	3,397	3,455	3,527	3,269	3,418
Kansas and Nebraska	8,356	8,736	9,561	9,812	9,181	9,051	9,090	9,472	9,619	9,547	9,165	9,075	8,702
Kentucky and Tennessee	2,073	2,033	2,101	2,236	2,393	2,395	2,392	2,378	2,074	2,211	2,042	1,998	1,963
Louisiana and Alabama	13,155	12,732	11,767	10,910	10,329	10,389	10,432	10,992	11,344	11,132	12,431	12,101	13,336
Maryland	769	1,033	1,246	1,215	958	959	1,072	779	863	877	898	867	776
Massachusetts and Rhode Island	776	852	595	683	596	711	808	671	874	931	987	1,077	1,016
Michigan	1,534	1,611	1,638	2,154	2,219	2,406	2,377	2,398	2,526	2,487	2,470	2,318	2,116
Mississippi	587	584	582	469	499	576	661	718	1,019	958	1,059	1,146	957
Missouri and Iowa	5,065	4,903	4,932	4,990	5,274	5,088	5,013	4,979	5,111	5,418	5,096	5,416	5,489
Montana	988	1,024	1,035	894	1,136	985	1,081	1,118	972	979	1,073	894	808
New Jersey	3,986	4,395	5,945	5,345	5,707	5,365	6,037	5,655	6,707	5,903	6,093	5,715	5,629
New Mexico	1,476	1,515	1,496	1,376	1,340	1,204	1,234	1,233	1,286	1,492	1,546	1,669	1,603
New York	1,359	1,134	1,247	1,151	1,120	1,221	1,017	1,306	1,281	1,084	912	1,002	1,088
Ohio	8,011	8,385	8,115	8,556	8,302	8,171	8,205	8,043	7,175	6,927	6,152	6,193	5,776
Oklahoma	31,844	32,497	32,815	32,569	32,547	32,408	32,197	31,646	31,361	30,622	30,954	30,466	30,055
Pennsylvania	6,128	6,223	7,387	6,954	6,638	6,196	7,354	7,235	7,100	7,039	5,926	6,446	5,795
Texas	84,815	85,679	85,728	80,685	82,615	84,392	83,435	84,606	83,993	84,203	84,785	88,197	86,460
Utah	261	289	268	315	318	356	386	413	389	389	377	307	273
West Virginia	886	889	863	841	831	786	819	739	744	747	784	737	735
Wyoming and Idaho	5,187	5,276	5,658	5,566	5,999	5,823	5,838	6,412	6,833	6,892	6,950	7,338	7,444
Total gasoline-bearing crude	218,763	223,442	227,220	221,400	222,480	221,592	223,140	224,351	224,157	222,417	222,177	226,453	224,473
Heavy crude in California	4,496	4,554	4,607	4,528	4,533	4,913	4,921	4,968	5,066	5,401	5,483	5,335	5,703
Total crude petroleum	223,259	227,996	231,827	225,928	227,013	226,505	228,061	229,319	229,223	227,818	227,660	231,788	230,176

[1] Final figures.

Stocks of crude petroleum in the United States in 1946, by States of origin and by months[1]

[Thousands of barrels]

State	Jan. 1	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
ORIGIN													
Alabama	40	60	70	70	40	51	60	50	56	38	52	59	38
Arkansas	2,506	2,740	2,583	2,660	2,568	2,586	2,594	2,647	2,661	2,719	2,805	2,797	2,813
California[2]	18,690	19,237	19,944	19,927	20,398	19,974	20,304	20,640	20,848	20,707	20,987	21,714	22,102
Colorado	566	573	499	975	910	1,115	1,104	1,448	1,629	1,602	1,286	1,467	1,467
Florida	4	7	6	4	6	11	12	12	10	15	15	12	17
Illinois	15,411	16,622	16,553	18,894	18,618	17,687	18,280	17,586	16,728	15,986	15,369	15,541	14,857
Indiana	195	175	185	159	129	124	132	114	116	177	172	267	145
Kansas	8,934	9,340	8,565	8,589	8,602	8,971	8,966	8,504	8,653	8,126	8,559	8,616	9,409
Kentucky	1,371	1,307	1,312	1,484	1,635	1,675	1,592	1,729	1,757	1,690	1,775	1,709	1,550
Louisiana	13,051	11,904	11,338	11,613	10,662	10,108	10,646	10,565	10,906	10,659	10,289	11,171	11,670
Michigan	1,137	1,095	1,083	1,255	1,193	1,290	1,214	1,298	1,508	1,436	1,464	1,392	1,234
Mississippi	2,319	2,310	2,111	2,288	2,247	2,494	2,181	2,577	2,817	2,517	2,737	2,743	2,791
Montana	904	925	934	830	1,059	932	1,000	1,002	934	835	908	735	654
New Mexico	5,966	5,996	6,914	6,466	6,418	6,337	6,041	6,008	6,396	5,719	6,153	6,422	6,280
New York	155	161	158	143	152	171	192	199	178	155	161	148	158
Ohio	488	531	512	536	599	601	617	609	598	630	651	655	645
Oklahoma	35,028	35,683	36,822	34,607	33,792	33,118	32,260	32,878	31,856	31,692	30,952	31,263	29,944
Pennsylvania	1,128	1,127	1,184	1,209	1,313	1,424	1,414	1,363	1,374	1,468	1,486	1,452	1,400
Texas	101,473	103,945	106,335	99,821	101,659	102,646	103,561	104,325	102,590	103,954	103,714	105,525	104,477
West Virginia	505	569	543	563	620	589	650	591	693	623	574	609	559
Wyoming	5,931	6,068	6,557	6,174	6,591	6,568	6,734	7,178	7,371	7,363	7,767	7,997	8,229
Nebraska and Missouri	26	28	26	26	26	26	26	25	24	24	24	24	19
Foreign	2,935	3,039	2,986	3,107	3,243	3,094	3,560	3,003	4,454	4,282	4,277	4,135	4,015
Total gasoline-bearing crude	218,763	223,442	227,220	221,400	222,480	221,592	223,140	224,351	224,157	222,417	222,177	226,453	224,473
California heavy crude	4,496	4,554	4,607	4,528	4,533	4,913	4,921	4,968	5,066	5,401	5,483	5,335	5,703
Total crude petroleum	223,259	227,996	231,827	225,928	227,013	226,505	228,061	229,319	229,223	227,818	227,660	231,788	230,176

[1] Final figures.
[2] Heavy crude stocks in California given below.

Stocks of crude petroleum in the United States in 1946, by States of location and by months [1]

[Thousands of barrels]

Classification	Jan. 1	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
At refineries:													
Arkansas	478	456	452	427	410	355	457	523	458	535	484	537	539
California and Washington	6,019	6,268	6,863	6,846	7,232	7,165	7,270	6,751	7,173	7,093	6,631	6,776	6,883
Colorado	315	303	252	249	291	364	345	304	319	312	264	262	236
Georgia, South Carolina, and Virginia	159	399	268	316	308	318	345	300	118	130	166	148	320
Illinois, Minnesota, and Wisconsin	2,823	2,770	2,719	2,935	2,695	2,621	2,477	2,078	2,600	2,461	2,324	2,254	2,174
Indiana	1,467	1,758	1,664	1,571	1,746	1,428	1,582	1,535	1,223	1,510	1,579	1,378	1,670
Kansas and Nebraska	1,975	1,995	2,098	2,027	2,242	2,291	2,305	2,295	2,256	1,662	1,874	1,972	1,871
Kentucky and Tennessee	714	657	679	869	938	862	850	895	738	900	676	753	802
Louisiana	3,565	3,427	3,646	2,674	2,889	3,122	3,000	3,242	3,349	3,599	4,315	4,238	5,083
Maryland	769	1,033	1,246	1,215	958	959	1,072	779	863	877	898	867	776
Massachusetts and Rhode Island	776	852	595	683	596	711	808	671	874	931	987	1,077	1,016
Michigan	460	571	625	1,102	1,229	1,259	1,325	1,318	1,366	1,314	1,291	1,228	1,098
Mississippi	5	5	5	8	8	8	14	15	13	4	6	6	6
Missouri and Iowa	245	246	234	244	247	260	210	211	215	221	278	260	283
Montana	454	408	416	310	491	393	398	446	329	272	378	276	194
New Jersey	3,805	4,251	5,794	5,136	5,570	5,195	5,793	5,385	6,454	5,654	5,802	5,469	5,425
New Mexico	69	70	53	56	44	56	47	45	46	57	57	50	63
New York	1,189	950	1,068	1,031	976	1,017	820	1,102	1,102	912	664	797	901
Ohio	1,790	1,853	1,709	1,939	1,443	1,474	1,409	1,196	780	1,324	1,025	1,170	1,322
Oklahoma	2,893	3,216	3,369	3,283	3,148	2,851	2,842	2,848	2,907	2,725	2,714	2,755	2,775
Pennsylvania	4,477	4,711	5,773	5,287	4,914	4,375	5,452	5,465	5,288	5,232	4,204	4,767	4,200
Texas	14,669	14,361	14,435	13,383	14,520	14,353	14,724	14,610	14,809	14,771	14,124	15,010	14,063
Utah	223	251	230	284	287	325	355	382	358	358	346	276	242
West Virginia	70	87	71	72	73	74	58	51	62	79	94	65	70
Wyoming and Idaho	867	921	1,166	1,181	1,274	1,152	1,161	1,085	1,085	961	893	953	1,101
Total at refineries	50,276	51,819	55,430	53,128	54,529	52,988	55,119	53,532	54,785	53,894	52,074	53,344	53,113
Pipe-line and tank-farm stocks:													
Arkansas	868	1,023	1,002	1,032	1,132	1,116	1,066	950	989	994	1,000	1,105	1,056
California	8,831	9,102	9,228	9,223	9,329	8,946	9,117	9,847	9,860	9,666	10,514	11,146	11,235
Colorado	218	244	195	201	224	304	315	328	332	312	320	304	291
Illinois	12,618	13,761	13,979	14,271	13,578	12,996	13,277	13,284	12,680	12,538	12,300	12,774	13,164
Indiana	2,692	2,538	2,615	2,561	2,544	2,424	2,282	2,400	2,109	1,880	1,883	1,826	1,683
Kansas and Nebraska	5,451	5,781	6,603	6,820	5,979	5,825	5,820	6,217	6,418	6,940	6,341	6,163	5,946
Kentucky and Tennessee	1,294	1,311	1,357	1,302	1,390	1,468	1,477	1,423	1,276	1,246	1,301	1,185	1,096
Louisiana and Alabama	8,619	8,324	7,190	7,230	6,434	6,266	6,386	6,720	7,004	6,532	7,129	6,852	7,227
Michigan	884	845	808	857	800	957	862	895	975	978	989	900	828
Mississippi	302	309	307	181	216	293	352	423	721	664	768	845	641
Missouri and Iowa	4,820	4,655	4,698	4,746	5,027	4,828	4,803	4,768	4,896	5,197	4,818	5,156	5,206
Montana	384	466	474	429	495	447	533	522	493	557	535	453	444
New Jersey	181	144	151	209	137	170	244	270	253	249	291	246	204

See footnote at end of table.

Stocks of crude petroleum in the United States in 1946, by States of location and months [1]—Continued

[Thousands of barrels]

Classification	Jan. 1	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
Pipe-line and tank-farm stocks—Continued.													
New Mexico	947	975	973	825	816	668	692	683	735	930	974	1,099	1,020
New York	140	154	149	90	114	174	167	174	149	142	218	175	157
Ohio	6,126	6,437	6,311	6,522	6,764	6,602	6,701	6,752	6,300	5,508	5,037	4,928	4,359
Oklahoma	27,706	28,016	28,206	27,911	28,089	28,267	28,025	27,553	27,214	26,602	26,990	26,416	26,085
Pennsylvania	1,476	1,337	1,439	1,492	1,549	1,646	1,762	1,630	1,672	1,667	1,582	1,539	1,425
Texas	65,811	66,783	66,903	62,937	63,715	65,604	64,061	65,391	64,614	64,882	66,301	68,642	67,802
Utah	38	38	38	31	31	31	31	31	31	31	31	31	31
West Virginia	646	632	622	599	588	542	621	548	517	503	530	512	500
Wyoming	3,905	3,915	4,067	3,950	4,235	4,191	4,192	4,847	5,263	5,451	5,582	5,910	5,838
Total pipe-line and tank-farm stocks	153,957	156,790	157,315	153,419	153,186	153,765	152,786	155,656	154,501	153,469	155,434	158,207	156,238
Producers' stocks	14,530	14,833	14,475	14,853	14,765	14,839	15,235	15,163	14,871	15,054	14,669	14,902	15,122
Total 1946 (final figures)	218,763	223,442	227,220	221,400	222,480	221,592	223,140	224,351	224,157	222,417	222,177	226,453	224,473
Total 1945 (final figures)	220,663	221,737	220,221	223,988	224,229	223,151	218,218	216,638	215,135	220,319	221,246	218,916	218,763

[1] Excludes stocks of California heavy crude.

The increase in residual fuel-oil stocks reflected the rapid shift from military to civilian use, and the gain in kerosine stocks was due to the expansion of heating- and range-oil demand. The decline in finished-gasoline stocks was related to the decline in total aviation-gasoline demand and the liquidation of stocks in military custody not included in the stocks reported to the Bureau of Mines.

PRICES AND VALUE

Complete data on crude-oil values in 1946 are not yet available, but the preliminary estimate of the value of all crude produced in 1946 is $1.41 per barrel compared with $1.22 in 1945. These averages represent the value of crude at the well and include subsidy payments under the stripper-well compensatory adjustment program.

The first change in posted crude prices came on April 1, when the Office of Price Administration permitted an increase of 10 cents per barrel. This increase was general throughout all producing areas and did not affect stripper-well subsidy payments. The second increase came near the end of July. In California the increases varied from 10 to 30 cents per barrel, depending on the gravity of the crude—the high-gravity crude receiving the greater increase. In the other crude-producing areas, the price rise amounted to 25 cents per barrel, and the effective dates varied from July 25 to August 1. The posted prices for Pennsylvania-Grade crude advanced again in the first week of September. The amount of the increase varied by areas: 6 cents per barrel for Bradford crude, 20 cents for Southwest Pennsylvania crude, and 26 cents for Southeast Ohio and West Virginia crude. Posted crude prices advanced again about the middle of November in all producing areas except California and the Pennsylvania-Grade region. This increase amounted to 10 cents per barrel and was followed on December 1 by an advance of 14 cents per barrel in the postings for Pennsylvania Grade.

Effective with the increase of 25 cents per barrel in the last week of July, the rate of payment under the stripper-well subsidy plan was reduced by an amount equal to the increase in posted price. After this increase, all payments of 25 cents per barrel or less were eliminated, and the rate of 35 cents per barrel was reduced to 10 cents. As almost all of the Pennsylvania-Grade crude was included in the plan at a rate of 75 cents per barrel, the increases in the posted prices after the middle of the year did not represent actual gains for the producers of crude in this area. However, the total of all subsidy payments for crude production in 1946 amounted to less than 2 percent of the value of all crude, and the reduction of payments in the last 5 months did not affect the average value for the year by more than 1 cent per barrel.

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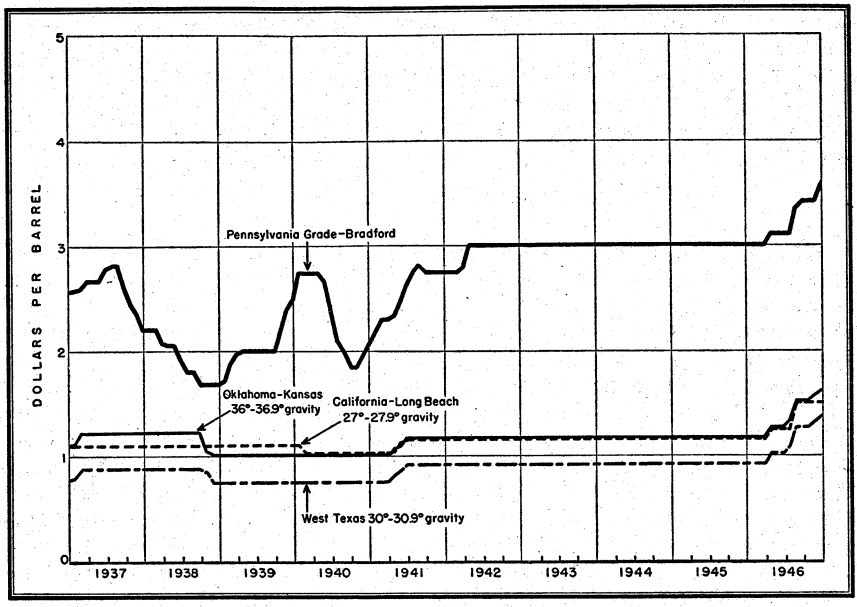

FIGURE 5.—Posted prices of selected grades of crude petroleum in the United States 1937–46, by months.

Value of crude petroleum at wells in the United States, 1944–45, by States [1]

State	1944		1945	
	Total (thousands of dollars)	Average per barrel	Total (thousands of dollars)	Average per barrel
Arkansas	30,890	$1.05	30,720	$1.07
California	330,800	1.06	347,330	1.06
Colorado	3,530	1.15	5,780	1.15
Illinois	107,370	1.39	105,130	1.40
Indiana	7,080	1.38	6,890	1.42
Kansas	120,290	1.22	119,520	1.24
Kentucky	13,640	1.42	15,260	1.48
Louisiana:				
Gulf Coast	129,500	1.23	132,850	1.24
Northern	29,100	1.21	28,410	1.20
Total Louisiana	158,600	1.22	161,260	1.23
Michigan	26,410	1.43	25,010	1.45
Mississippi	16,730	1.02	19,240	1.01
Montana	10,700	1.24	10,810	1.28
Nebraska	460	1.10	370	1.21
New Mexico	39,600	1.00	37,610	1.01
New York	15,640	3.33	17,470	3.76
Ohio	6,560	2.23	7,240	2.56
Oklahoma	153,290	1.23	177,050	1.27
Pennsylvania	46,400	3.29	46,680	3.73
Texas:				
Gulf Coast	341,590	1.31	331,380	1.31
East Texas proper	168,990	1.25	164,000	1.25
West Texas	160,210	1.00	175,730	1.00
Other	231,870	1.22	243,300	1.25
Total Texas	902,660	1.21	914,410	1.21
West Virginia	8,910	2.90	9,620	3.34
Wyoming	33,290	1.00	36,610	1.01
Other States [2]	110	.98	240	.90
Total	2,032,960	1.21	2,094,250	1.22

[1] Figures for 1946 not yet available.
[2] Alabama, Florida, Missouri, Tennessee, and Virginia.

Posted price per barrel of petroleum at wells in the United States in 1946, by grades, with dates of change

Date	Pennsylvania Grade		Corning Grade in Buckeye Pipe Line Co. [2]	Western Kentucky [3]	Illinois Basin [4]	Midland, Mich. [5]	Oklahoma-Kansas [6]	
	Bradford and Allegany districts [1]	In Southwest Pennsylvania pipe lines [2]					34°–34.9°	36°–36.9°
January 1	$3.00	$2.65	$1.31	$1.37	$1.37	$1.44	$1.13	$1.17
April 1	3.10	2.75	1.41	1.47	1.47	1.54	1.23	1.27
July 25				1.72	1.72	1.79	1.48	1.52
August 1	3.35	3.00	1.66					
September 1	3.41	3.20						
November 15			1.76	1.82	1.82	1.89	1.58	1.62
December 1	3.55	3.34						

Date	Panhandle Texas (Carson, Gray, Hutchinson, and Wheeler Counties), 35°–35.9° [7]	West Texas, 30°–30.9° [7]	Lea County, N. Mex., 30°–30.9° [7]	South Texas, Duval-Mirando, 22°–22.9° [7]	East Texas [7]	Gulf Coast			
						Conroe, Tex. [8]	Texas 30°–30.9° [8]	Texas 20°–20.9° [8]	Louisiana 30°–30.9° [9]
January 1	$1.12	$0.92	$0.92	$1.09	$1.25	$1.43	$1.28	$1.08	$1.10
April 1	1.22	1.02	1.02	1.19	1.35	1.53	1.38	1.18	1.20
July 25	1.50	1.27	1.27	1.44	1.60	1.78	1.63	1.43	1.50
November 15	1.60	1.37	1.37	1.54	1.70	1.88	1.73	1.53	1.60

Date	Rodessa, La., 36°–36.9° [9]	Smackover, Ark. [10]	Salt Creek, Wyo., 36°–36.9° [11]	Lance Creek, Wyo., 40° and above [4]	California [12]			
					Coalinga 32°–32.9°	Kettleman 37°–37.9°	Midway-Sunset, 19°–19.9°	Wilmington 24°–24.9°
January 1	$1.12	$0.98	$1.17	$1.25	$1.09	$1.29	$0.98	$1.06
April 1	1.22	1.08	1.27	1.35	1.19	1.39	1.08	1.16
July 25	1.52	1.28	1.52	1.60				
August 1					1.48	1.69	1.18	1.42
November 15	1.62	1.38	1.62	1.70				

[1] The Tide Water Associated Oil Co.
[2] The South Penn Oil Co.
[3] Sohio Corp.
[4] The Ohio Oil Co.
[5] The Pure Oil Co.
[6] Standard Oil Co. (Indiana).
[7] Humble Oil & Refining Co.
[8] The Texas Co.
[9] Standard Oil Co. of New Jersey.
[10] Arkansas Fuel Oil Co.
[11] Stanolind Oil & Gas Co.
[12] Standard Oil Co. of California.

REFINED PRODUCTS

GENERAL REVIEW

The demand for refined products in 1946 reflects a continuation of the shift from wartime operations to a postwar demand pattern. Wartime demand was marked by restricted civilian consumption and by military purchases and lend-lease exports. Since most of the military purchases and all of the lend-lease exports were lifted from ports on the east coast, Gulf coast, or California, the major wartime supply and transportation problems were related to the demands in these areas. The end of the war brought a rapid decline in military purchases and in lend-lease exports. Removal of most of the wartime controls was followed by a substantial increase in civilian consump-

tion. This shift from military and export demand to civilian demand created the first important postwar distribution problem—that of supplying areas of high civilian demand. The Gulf Coast area, with a surplus of both crude and refined products, could ship by tanker to the high-demand area on the east coast, and production in California could meet the needs of the west coast area; but no large surplus shipping capacity was available for the movement of crude and products into the North Central States. By the end of 1946, additional pipe lines were under construction, but a shortage of transportation into this area was indicated for 1947.

The small decline in total demand for all oils from 1,956 million barrels in 1945 to 1,942 million in 1946 was due to the sharp drop in exports of refined products. These exports decreased from 150 million barrels in 1945 to 110 million barrels in 1946—a 27-percent decline. Domestic demand for all oils (including military purchases of domestic-origin products and imports into continental United States for military consumption) rose from 1,773 million barrels in 1945 to 1,791 million barrels in 1946. The increases in civilian consumption compensated for the drop in military purchases and produced a net gain of 18 million barrels in domestic demand. Most of the military requirements for aviation gasoline in 1946 were supplied from surplus stocks in military custody at the end of the war. Since the stocks reported to the Bureau

Runs to stills and production at refineries in the United States of the various refined petroleum products, 1942–46

[Thousands of barrels, except as otherwise indicated]

Product	1942	1943	1944	1945	1946 [1]
Input:					
Crude petroleum:					
Domestic	1,319,507	1,417,559	1,622,514	1,645,862	1,645,845
Foreign	14,596	12,179	43,170	73,672	84,352
Total crude petroleum	1,334,103	1,429,738	1,665,684	1,719,534	1,730,197
Natural gasoline	56,595	61,198	67,207	70,324	62,861
Total input	1,390,698	1,490,936	1,732,891	1,789,858	1,793,058
Output:					
Gasoline	586,971	592,425	722,718	774,460	748,411
Kerosine	67,474	72,270	78,344	81,024	104,385
Distillate fuel oil	196,714	211,516	239,152	249,224	287,896
Residual fuel oil	358,901	417,306	461,455	469,492	431,364
Lubricating oil	38,626	38,679	41,106	41,867	45,645
Wax [2]	2,502	2,697	2,883	2,921	3,003
Coke [2]	6,692	6,942	9,017	10,115	10,621
Asphalt [2]	34,631	37,162	38,479	39,196	44,911
Still gas [2]	78,924	86,755	102,239	103,458	88,136
Wax—thousands of pounds	700,560	755,160	807,240	817,880	840,840
Coke—thousands of short tons	1,338.4	1,388.4	1,803.4	2,023.0	2,124.2
Asphalt—do	6,296.5	6,756.7	6,996.1	7,126.6	8,165.6
Still gas—millions of cubic feet	284,126	312,318	368,061	372,449	317,290
Road oil	8,039	2,295	1,556	2,686	6,175
Other finished products	8,117	9,660	18,436	19,080	22,539
Crude gasoline (net)	1,669	1,009	1,745	[3] 4,892	[3] 108
Other unfinished oils (net)	[3] 3,353	2,597	2,584	[3] 5,727	[3] 1,615
Shortage	4,791	9,623	13,177	6,954	1,695
Total output	1,390,698	1,490,936	1,732,891	1,789,858	1,793,058

[1] Subject to revision.
[2] Conversion factors: 280 pounds of wax to the barrel, 5.0 barrels of coke to the short ton, 5.5 barrels of asphalt to the short ton, 3,600 cubic feet of still gas to the barrel.
[3] Negative quantity; represents net excess of unfinished oils rerun over unfinished oils produced.

of Mines do not include any products in military custody, the military requirements supplied by liquidation of military stocks were not part of the indicated demand for 1946. The domestic demand for 1946 would have been higher if all military requirements had been supplied from current production. The domestic demand for motor fuel in 1946 increased 38.5 million barrels, the demand for kerosine gained 13.6 million, distillate demand rose 16.9 million, and the domestic demand for residual fuel declined 46.3 million.

Salient statistics of the major refined petroleum products in the United States, 1942–46

[Thousands of barrels, except as otherwise indicated]

Product	1942	1943	1944	1945	1946 [1]
Motor fuel:					
Production	608,900	608,180	739,340	798,194	776,054
Imports	115	5,736	3,148	1,807	1
Exports	35,097	51,577	100,537	88,059	45,389
Stocks, end of year	75,404	{ 69,505 / [2] 68,405	77,874 / [2] 78,073	93,682	89,515
Domestic demand	589,110	568,238	632,482	696,333	734,833
Kerosine:					
Production	67,474	72,270	78,344	81,024	104,385
Imports	418	375	147		
Exports	2,576	4,752	4,888	6,180	8,559
Stocks, end of year	10,064	9,359	11,150	10,421	17,081
Domestic demand	69,767	68,598	71,812	75,573	89,166
Distillate fuel oil:					
Production	196,714	211,516	239,152	249,224	287,896
Transfers	2,496	3,070	3,242	3,047	3,123
Imports	3,636	15,269	7,022	4,754	5,141
Exports	21,575	24,957	43,491	33,496	29,353
Stocks, end of year	44,940	41,728	38,333	35,778	59,620
Domestic demand	185,661	208,110	209,320	226,084	242,965
Residual fuel oil:					
Production	358,901	417,306	461,455	469,492	431,364
Transfers	19,283	24,087	28,515	20,727	23,142
Imports	18,432	27,210	36,485	31,648	42,067
Exports	12,095	14,894	12,536	11,669	9,486
Stocks, end of year	61,783	48,484	50,383	37,158	47,094
Domestic demand	405,697	467,008	512,020	523,423	477,151
Lubricating oil:					
Production	38,626	38,679	41,106	41,867	45,645
Imports					88
Exports	8,272	8,863	8,709	6,575	11,058
Stocks, end of year	9,424	7,781	7,815	7,773	7,564
Domestic demand	29,057	31,459	32,363	35,334	34,884
Wax (thousands of pounds):					
Production	700,560	755,160	807,240	817,880	840,840
Imports	9,749	109		1,798	131
Exports	153,519	172,799	162,236	158,526	200,836
Stocks, end of year	85,400	82,040	93,800	82,040	86,240
Domestic demand	546,204	585,330	633,244	672,912	635,935
Coke (thousands of short tons):					
Production	1,338.4	1,388.4	1,803.4	2,023.0	2,124.2
Exports	325.3	314.0	209.0	209.2	386.2
Stocks, end of year	233.8	258.2	187.2	158.2	90.0
Domestic demand	1,007.3	1,050.0	1,665.4	1,842.8	1,806.2
Asphalt (thousands of short tons):					
Production	6,296.5	6,756.7	6,996.1	7,126.6	8,165.6
Imports	121.2	113.0	126.4	147.1	125.7
Exports	113.8	98.9	127.1	234.4	372.3
Stocks, end of year	411.0	563.3	626.2	692.7	702.0
Domestic demand	6,496.9	6,618.5	6,932.5	6,972.8	7,909.7

See footnotes at end of table.

Salient statistics of the major refined petroleum products in the United States, 1942–46—Continued

Product	1942	1943	1944	1945	1946 [1]
Road oil:					
Production	8,039	2,295	1,556	2,686	6,175
Stocks, end of year	348	193	189	370	606
Domestic demand	8,484	2,450	1,560	2,505	5,939
Other finished products:					
Production	8,117	9,660	18,436	19,080	22,539
Transfers of L. P. G. from natural gasoline	7,195	11,589	16,796	19,978	25,458
Exports	657	841	893	1,105	1,912
Stocks, end of year	597	734	965	1,061	1,120
Domestic demand	14,547	20,271	34,108	37,857	46,026
Unfinished gasoline:					
Rerun (net)	[3] 1,669	[3] 1,009	[3] 1,745	4,892	108
Stocks, end of year	9,354	{ 10,363 [2] 11,463 }	13,208	8,316	8,208
Other unfinished oils:					
Rerun (net)	3,353	[3] 2,597	[3] 2,584	5,727	1,615
Transfers of cycle products	([4])	1,574	1,821	848	1,261
Imports	366	366	9	258	978
Stocks, end of year	36,537	41,074	45,488	40,867	41,491
Shortage	4,791	9,623	13,177	6,954	1,695

[1] Subject to revision.
[2] New basis, to compare with following year.
[3] Negative quantity; represents net excess of unfinished produced over unfinished rerun.
[4] Figure not available.

Imports of refined products increased 9.7 million barrels in 1946. The major changes included an increase of 10.4 million barrels in imports of residual fuel, a small gain in distillate fuel, and a decrease of 1.8 million barrels in imports of motor fuel.

Crude runs to stills increased from 1,720 million barrels in 1945 to 1,730 million in 1946—a gain of 10 million barrels and a new record for total crude runs.

The changes in refinery yields from crude in 1946 reflect both a shift in product demand and an adjustment in product stock levels to match the postwar demand pattern. The decline in the export demand for motor fuel and the relatively high position of gasoline stocks at the end of 1945 resulted in a decline in the percentage yield

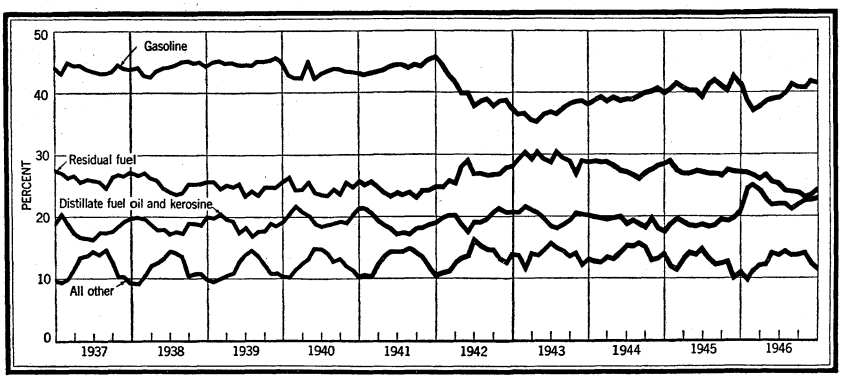

FIGURE 6.—Yields of principal products from crude oil run to stills in the United States 1937–46, by months.

of gasoline from 40.9 in 1945 to 39.6 in 1946. The very marked increase in the use of distillate fuels for heating and for Diesel engines, together with a stock program in 1946 to meet the needs of the 1946–47 heating season, required a change in the yield of distillate from 14.5 percent in 1945 to 16.6 percent in 1946. Both domestic and export demands for kerosine increased in 1946, and the percentage yield rose from 4.7 to 6.0. The postwar decline in the demand for residual fuel is reflected in the drop in the yield of this product from 27.3 percent in 1945 to 24.9 percent in 1946.

Percentage yields of refined petroleum products in the United States, 1937–46

[Computed on total crude runs to stills]

Product	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946 [1]
Finished product:										
Gasoline:										
Cracked	22.6	23.2	23.9	22.7	24.4	22.3	22.0	23.2	23.3	22.5
Straight run	21.3	21.1	21.1	20.4	19.8	17.5	15.1	16.2	17.6	17.1
Total gasoline	43.9	44.3	45.0	43.1	44.2	39.8	37.1	39.4	40.9	39.6
Kerosine	5.5	5.5	5.5	5.7	5.2	5.1	5.0	4.7	4.7	6.0
Distillate fuel oil	12.4	13.0	13.1	14.2	13.4	14.7	14.8	14.4	14.5	16.6
Residual fuel oil	26.4	25.3	24.7	24.4	24.3	26.9	29.2	27.7	27.3	24.9
Lubricating oil	3.0	2.6	2.8	2.8	2.8	2.9	2.7	2.5	2.4	2.7
Wax	.2	.1	.1	.1	.2	.2	.2	.2	.2	.2
Coke	.6	.7	.7	.6	.6	.5	.5	.5	.6	.6
Asphalt	1.9	2.1	2.2	2.3	2.6	2.6	2.6	2.3	2.3	2.6
Road oil	.7	.6	.6	.6	.6	.6	.2	.1	.2	.4
Still gas	5.4	5.7	5.5	5.5	5.9	5.9	6.1	6.1	6.0	5.1
Other	.2	.2	.2	.3	.4	.6	.7	1.1	1.1	1.3
Unfinished products:										
Gasoline	([2])	[3].1	([2])	.1	.1	.1	([2])	.1	[3].3	([2])
Other	[3].7	[3].4	[3].9	[3].3	[3].2	[3].3	.2	.1	[3].3	[3].1
Shortage	.5	.4	.5	.6	[4].1	.4	.7	.8	.4	.1
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Subject to revision.
[2] Less than 0.1 percent.
[3] Negative percentage; represents excess percentage rerun over percentage produced.
[4] Negative quantity (overage).

Stocks of refined oils at the end of 1946 amounted to 272 million barrels compared with 236 million on December 31, 1945. The principal changes in 1946 were an increase of 24 million barrels in the stocks of distillate, a gain of 10 million in residual stocks, an increase of 7 million in kerosine stocks, and a reduction of 5 million in the stocks of finished gasoline. Stocks may be expressed in terms of days' supply by a ratio of stocks to daily average demand for the succeeding month. The stocks of distillate at the end of 1941 represented 59 days' supply compared with a 35-day supply on hand at the end of 1945 and a 51-day supply on December 31, 1946. Stocks of residual fuel at the end of 1941 represented 66 days' supply; but because of the heavy wartime liquidation, particularly in California, the inventories of this product at the end of 1945 had declined to a 25-day supply. Residual stocks increased in 1946, and at the end of the year the inventories represented 30 days' supply.

Stocks of refined petroleum products in the United States, 1945–46, by months

[Thousands of barrels, except as otherwise indicated]

Product	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
1945												
Gasoline	78,877	85,473	85,654	79,653	77,151	74,089	74,460	74,270	65,489	68,039	78,091	89,360
Kerosine	8,742	7,150	6,925	8,252	8,574	9,599	11,157	13,894	13,675	12,708	12,141	10,421
Distillate fuel oil	31,695	27,210	26,729	29,148	29,511	32,440	36,276	41,245	45,059	45,479	44,562	35,778
Residual fuel oil	44,347	39,760	35,451	34,418	34,333	35,606	38,341	42,227	42,822	42,068	41,322	37,158
Lubricating oil	7,796	7,641	7,423	7,307	7,026	6,770	6,321	6,505	6,840	7,221	7,595	7,773
Wax [1]	316	308	312	303	290	255	281	295	301	301	297	293
Coke [1]	872	656	624	704	752	738	770	802	811	795	797	791
Asphalt [1]	4,015	4,445	4,741	5,001	5,035	4,594	4,019	3,257	2,883	2,767	3,071	3,810
Wax—thousands of pounds	88,480	86,240	87,360	84,840	81,200	71,400	78,680	82,600	84,280	84,280	83,160	82,040
Coke—thousands of short tons	174.4	131.2	124.8	140.8	150.4	147.6	154.0	160.4	162.2	159.0	159.4	158.2
Asphalt—do	730.0	808.2	862.0	909.3	915.5	835.3	730.7	592.2	524.2	503.1	558.4	692.7
Road oil	237	248	326	438	595	394	361	348	357	330	342	370
Other finished products	969	999	1,056	1,051	978	1,049	1,025	997	1,000	1,003	1,084	1,061
Unfinished gasoline	12,789	11,984	11,793	11,151	11,179	12,039	11,122	9,733	9,085	8,766	8,449	8,316
Other unfinished oils	43,970	42,563	42,256	43,017	43,140	43,616	43,257	42,764	42,821	43,585	41,526	40,867
Total 1945	234,625	228,437	223,290	220,443	218,564	221,189	227,390	236,337	231,143	233,062	239,277	235,998
1946												
Gasoline	94,115	96,293	95,186	90,444	85,801	83,726	79,384	78,833	78,848	77,628	79,980	84,534
Kerosine	8,330	7,848	9,292	10,992	12,741	14,318	16,403	19,458	21,251	21,978	20,528	17,081
Distillate fuel oil	28,990	25,511	29,922	32,064	33,885	38,824	46,439	54,068	62,019	67,870	68,145	59,620
Residual fuel oil	34,573	34,008	32,995	35,206	38,932	41,492	45,446	48,186	54,012	55,580	52,735	47,094
Lubricating oil	7,694	7,966	7,951	7,852	7,565	7,635	7,293	7,030	7,244	7,338	7,384	7,564
Wax [1]	288	291	305	289	276	292	264	262	297	303	321	308
Coke [1]	732	734	709	722	600	425	390	358	445	478	467	450
Asphalt [1]	4,326	4,893	5,216	5,424	5,627	4,992	4,508	3,805	3,446	3,178	3,422	3,861
Wax—thousands of pounds	80,640	81,480	85,400	80,920	77,280	81,760	73,920	73,360	83,160	84,840	89,880	86,240
Coke—thousands of short tons	146.4	146.8	141.8	144.4	120.0	85.0	78.0	71.6	89.0	95.6	93.4	90.0
Asphalt—do	786.5	889.6	948.4	986.2	1,023.1	907.6	819.6	691.8	626.5	577.8	622.2	702.0
Road oil	304	405	427	642	880	1,000	977	828	634	579	562	606
Other finished products	1,058	979	1,101	1,112	1,128	1,107	1,087	1,246	1,205	1,223	1,170	1,120
Unfinished gasoline	8,279	8,543	8,975	8,300	8,159	8,245	8,394	7,912	8,173	8,324	8,607	8,208
Other unfinished oils	39,524	39,288	39,479	39,535	41,913	42,495	43,533	43,415	43,091	43,470	42,446	41,491
Total 1946	228,213	226,759	231,558	232,582	237,507	244,551	254,118	265,401	280,665	287,949	285,767	271,937

[1] Conversion factors: 280 pounds of wax to the barrel; 5.0 barrels of coke to the short ton; 5.5 barrels of asphalt to the short ton.

Runs to stills and production at refineries in the United States of the various refined petroleum products, 1945–46, by months

[Thousands of barrels, except as otherwise indicated]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1945													
Input:													
Crude petroleum	145,071	134,882	146,285	143,221	152,295	149,682	155,040	152,771	128,236	131,567	138,705	141,779	1,719,534
Natural gasoline	6,380	5,457	6,138	6,077	6,114	6,065	6,551	6,236	5,081	5,483	5,425	5,317	70,324
Total input	151,451	140,339	152,423	149,298	158,409	155,747	161,591	159,007	133,317	137,050	144,130	147,096	1,789,858
Output:													
Gasoline	64,909	61,445	65,830	63,807	67,547	64,972	70,704	70,328	57,988	58,542	64,682	63,706	774,460
Kerosine	6,614	6,291	7,056	6,260	6,445	6,337	6,520	7,089	5,858	6,447	7,564	8,543	81,024
Distillate fuel oil	20,556	20,267	20,934	20,443	21,941	21,891	22,099	21,740	19,204	19,009	19,964	21,176	249,224
Residual fuel oil	41,862	37,141	39,471	38,660	41,569	40,527	41,881	41,200	34,183	36,452	37,937	38,609	469,492
Lubricating oil	3,504	3,062	3,589	3,716	3,882	3,567	3,645	3,712	3,128	3,265	3,485	3,312	41,867
Wax [1]	257	232	291	252	254	251	255	262	193	208	238	228	2,921
Coke [1]	907	815	862	921	893	858	924	902	741	718	760	814	10,115
Asphalt [1]	2,592	2,315	2,569	2,882	3,471	3,746	4,346	4,249	3,646	3,575	3,104	2,701	39,196
Still gas [1]	9,134	8,397	9,552	9,241	9,474	9,482	9,638	9,069	7,319	7,006	7,618	7,528	103,458
Wax—thousands of pounds	71,960	64,960	81,480	70,560	71,120	70,280	71,400	73,360	54,040	58,240	66,640	63,840	817,880
Coke—thousands of short tons	181.4	163.0	172.4	184.2	178.6	171.6	184.8	180.4	148.2	143.6	152.0	162.8	2,023.0
Asphalt—do	471.2	420.9	467.1	524.0	631.1	681.1	790.2	772.6	662.9	650.0	564.4	491.1	7,126.6
Still gas—millions of cubic feet	32,882	30,229	34,387	33,268	34,106	34,136	34,697	32,648	26,348	25,222	27,425	27,101	372,449
Road oil	123	94	154	192	269	361	220	374	386	316	99	98	2,686
Other finished products	1,932	1,834	1,776	1,775	1,735	1,784	1,691	1,335	1,143	1,202	1,463	1,410	19,080
Unfinished gasoline (net)	[2] 419	[2] 805	[2] 191	[2] 642	28	860	[2] 917	[2] 1,389	[2] 648	[2] 319	[2] 317	[2] 133	[2] 4,892
Other unfinished oils (net)	[2] 1,590	[2] 1,479	[2] 393	679	50	400	[2] 436	[2] 549	17	646	[2] 2,135	[2] 937	[2] 5,727
Shortage	1,070	730	923	1,112	851	711	1,021	685	159	[3] 17	[3] 332	41	6,954
Total output	151,451	140,339	152,423	149,298	158,409	155,747	161,591	159,007	133,317	137,050	144,130	147,096	1,789,858

See footnotes at end of table.

Runs to stills and production at refineries in the United States of the various refined petroleum products, 1945-46, by months—Continued

[Thousands of barrels, except as otherwise indicated]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1946 [4]													
Input:													
Crude petroleum	140,130	130,232	144,488	139,884	148,621	145,069	150,541	150,550	145,181	146,816	140,514	148,171	1,730,197
Natural gasoline	5,037	4,448	4,619	4,487	4,869	4,940	5,229	5,774	5,390	6,023	6,232	5,813	62,861
Total input	145,167	134,680	149,107	144,371	153,490	150,009	155,770	156,324	150,571	152,839	146,746	153,984	1,793,058
Output:													
Gasoline	59,338	52,751	58,914	58,276	62,482	61,645	65,150	67,853	64,304	65,630	64,868	67,200	748,411
Kerosine	9,688	9,506	9,852	8,396	8,887	8,376	8,435	8,179	7,825	8,566	7,893	8,782	104,385
Distillate fuel oil	24,390	23,047	25,298	23,181	23,348	23,320	24,589	23,703	23,877	24,432	23,741	24,970	287,896
Residual fuel oil	37,940	34,791	37,598	37,407	37,816	36,569	36,060	35,942	34,512	33,777	33,015	35,937	431,364
Lubricating oil	3,395	3,159	3,786	3,693	3,722	3,839	3,620	4,096	4,016	4,327	3,857	4,135	45,645
Wax [1]	234	232	276	243	242	234	216	247	245	266	283	285	3,003
Coke [1]	803	745	833	906	822	795	840	929	949	1,061	953	985	10,621
Asphalt [1]	2,527	2,636	2,973	3,260	3,915	4,060	4,685	4,792	4,553	4,436	3,687	3,387	44,911
Still gas [1]	6,864	6,254	7,106	7,158	7,553	7,570	7,969	8,035	7,548	7,606	7,140	7,333	88,136
Wax—thousands of pounds	65,520	64,960	77,280	68,040	67,760	65,520	60,480	69,160	68,600	74,480	79,240	79,800	840,840
Coke—thousands of short tons	160.6	149.0	166.6	181.2	164.4	159.0	168.0	185.8	189.8	212.2	190.6	197.0	2,124.2
Asphalt—do	459.5	479.3	540.5	592.7	711.8	738.2	851.8	871.3	827.8	806.5	670.4	615.8	8,165.6
Still gas—millions of cubic feet	24,710	22,514	25,582	25,769	27,191	27,252	28,688	28,926	72,173	27,382	25,704	26,399	317,290
Road oil	38	160	86	409	635	756	1,093	1,179	813	465	251	290	6,175
Other finished products	1,467	1,454	1,698	1,727	1,872	1,966	1,819	2,110	2,120	2,136	2,039	2,131	22,539
Unfinished gasoline (net)	[2] 37	264	432	[2] 675	[2] 141	86	149	[2] 482	261	151	283	[2] 399	[2] 108
Other unfinished oils (net)	[2] 1,533	[2] 416	62	[2] 86	2,140	330	857	[2] 320	[2] 446	226	[2] 1,284	[2] 1,145	[2] 1,615
Shortage	53	97	193	476	197	463	288	61	[3] 6	[3] 240	20	93	1,695
Total output	145,167	134,680	149,107	144,371	153,490	150,009	155,770	156,324	150,571	152,839	146,746	153,984	1,793,058

[1] Conversion factors: 280 pounds of wax to the barrel; 5.0 barrels of coke to the short ton; 5.5 barrels of asphalt to the short ton; 3,600 cubic feet of still gas to the barrel.
[2] Negative quantity; represents net excess rerun over production.
[3] Negative quantity (overage).
[4] Subject to revision.

Runs to stills and production at refineries in the United States of the various refined petroleum products, 1945–46, by districts

Thousands of barrels, except as otherwise indicated]

	East Coast	Appalachian	Indiana, Illinois, Kentucky, etc.	Oklahoma, Kansas, and Missouri	Texas Inland	Texas Gulf Coast	Louisiana Gulf Coast	Arkansas-Louisiana Inland	Rocky Mountain	California	Total United States
1945											
Input:											
Crude petroleum	273,667	56,199	275,853	139,176	84,510	403,417	99,309	27,937	45,944	313,522	1,719,534
Natural gasoline	1,687	435	8,309	5,310	10,043	20,334	3,325	2,238	1,502	17,141	70,324
Total input	275,354	56,634	284,162	144,486	94,553	423,751	102,634	30,175	47,446	330,663	1,789,858
Output:											
Gasoline	98,207	25,895	143,826	72,746	48,595	185,744	44,552	11,573	21,864	121,094	774,460
Kerosine	10,755	3,288	12,719	8,039	4,626	22,924	12,178	2,546	1,117	2,832	81,024
Distillate fuel oil	50,243	6,101	34,601	20,500	6,146	73,677	19,710	3,409	5,135	29,702	249,224
Residual fuel oil	85,352	9,152	53,494	24,764	22,471	88,617	17,062	6,331	13,253	148,976	469,492
Lubricating oil	8,358	4,891	4,446	5,361	248	10,989	2,036	1,453	265	3,820	41,867
Wax [1]	1,105	366	215	322	8	436	294	----------	90	85	2,921
Coke [1]	368	151	5,694	743	631	1,004	705	----------	194	625	10,115
Asphalt [1]	8,812	1,733	7,978	3,693	1,735	1,730	2,249	2,217	1,594	7,455	39,196
Still gas [1]	13,763	3,509	17,433	7,358	4,480	30,063	9,507	1,683	2,254	13,408	103,458
Wax—thousands of pounds	309,400	102,480	60,200	90,160	2,240	122,080	82,320	----------	25,200	23,800	817,880
Coke—thousands of short tons	73.6	30.2	1,138.8	148.6	126.2	200.8	141.0	----------	38.8	125.0	2,023.0
Asphalt—do	1,602.2	315.1	1,450.7	671.5	315.2	314.7	408.9	403.0	289.9	1,355.4	7,126.6
Still gas—millions of cubic feet	49,547	12,632	62,759	26,489	16,128	108,227	34,225	6,059	8,114	48,269	372,449
Road oil	289	----------	539	298	----------	26	1	37	821	675	2,686
Other finished products	3,388	728	1,485	364	1,951	6,219	2,882	175	116	1,772	19,080
Unfinished gasoline (net)	[2] 1,234	146	318	[2] 669	2,253	[2] 2,793	[2] 660	[2] 22	[2] 66	[2] 2,165	[2] 4,892
Other unfinished oils (net)	[2] 3,661	[2] 101	735	[2] 902	[2] 752	5,485	[2] 6,343	832	6	[2] 1,026	[2] 5,727
Shortage	[3] 391	775	679	1,869	1,777	[3] 370	[3] 1,539	[3] 59	803	3,410	6,954
Total output	275,354	56,634	284,162	144,486	94,553	423,751	102,634	30,175	47,446	330,663	1,789,858

See footnotes at end of table.

Runs to stills and production at refineries in the United States of the various refined petroleum products, 1945–46, by districts—Con.

[Thousands of barrels, except as otherwise indicated]

	East Coast	Appalachian	Indiana, Illinois, Kentucky, etc.	Oklahoma, Kansas, and Missouri	Texas Inland	Texas Gulf Coast	Louisiana Gulf Coast	Arkansas-Louisiana Inland	Rocky Mountain	California	Total United States
1946 [4]											
Input:											
Crude petroleum	276,651	55,756	279,810	138,385	78,812	424,619	121,215	21,967	48,044	284,938	1,730,197
Natural gasoline	1,181	505	7,080	5,594	10,978	15,642	2,533	1,371	1,023	16,954	62,861
Total input	277,832	56,261	286,890	143,979	89,790	440,261	123,748	23,338	49,067	301,892	1,793,058
Output:											
Gasoline	95,303	25,914	140,722	71,102	48,371	177,322	49,481	8,246	21,578	110,372	748,411
Kerosine	13,832	3,309	15,156	9,116	4,673	35,284	15,954	2,067	1,136	3,858	104,385
Distillate fuel oil	55,252	6,015	36,861	21,457	5,362	86,469	25,590	3,131	6,609	41,150	287,896
Residual fuel oil	80,007	8,616	54,323	23,406	20,092	90,200	17,040	5,068	13,388	119,224	431,364
Lubricating oil	9,332	5,175	4,800	5,479	282	13,399	2,098	1,380	278	3,422	45,645
Wax [1]	1,108	357	192	382	9	465	320	----------	78	92	3,003
Coke [1]	598	146	5,171	694	659	1,139	1,045	----------	221	948	10,621
Asphalt [1]	11,563	2,046	10,366	3,851	2,028	2,172	2,748	2,506	1,348	6,283	44,911
Still gas [1]	12,691	3,436	16,899	6,732	4,368	23,095	6,212	1,322	2,137	11,244	88,136
Wax—thousands of pounds	310,240	99,960	53,760	106,960	2,520	130,200	89,600	----------	21,840	25,760	840,840
Coke—thousands of short tons	119.6	29.2	1,034.2	138.8	131.8	227.8	209.0	----------	44.2	189.6	2,124.2
Asphalt—do	2,102.4	372.0	1,884.0	700.2	368.7	394.9	499.6	455.6	245.1	1,142.4	8,165.6
Still gas—millions of cubic feet	45,688	12,370	60,837	24,235	15,725	83,142	22,363	4,759	7,693	40,478	317,290
Road oil	172	----------	1,701	758	----------	102	2	20	1,160	2,260	6,175
Other finished products	2,754	602	2,533	586	906	8,185	4,559	156	151	2,107	22,539
Unfinished gasoline (net)	704	[2] 134	[2] 287	[2] 44	1,274	[2] 1,769	[2] 20	1	9	158	[2] 108
Other unfinished oils (net)	[2] 4,734	[2] 69	[2] 792	[2] 615	[2] 606	4,808	217	[2] 29	237	[2] 32	[2] 1,615
Shortage	[3] 750	848	[3] 755	1,075	2,372	[3] 610	[3] 1,498	[3] 530	737	806	1,695
Total output	277,832	56,261	286,890	143,979	89,790	440,261	123,748	23,338	49,067	301,892	1,793,058

[1] Conversion factors: 280 pounds of wax to the barrel; 5.0 barrels of coke to the short ton; 5.5 barrels of asphalt to the short ton; 3,600 cubic feet of still gas to the barrel.
[2] Negative quantity; represents net excess rerun over production.
[3] Negative quantity (overage).
[4] Subject to revision.

Price increases of representative refined products in 1946 reflected the increases in crude-oil prices and the removal of price controls. Most of the major price adjustments came in the latter half of the year. The price of Regular Grade gasoline at Oklahoma refineries declined in the first quarter and increased in each of the remaining months of the year with the largest increase in August. The average price for December was 7.25 cents per gallon compared with 5.81 cents per gallon for December 1945. The tank-wagon price of kerosine at Chicago increased in January, July, and November. The price in December was 12.20 cents per gallon compared with 10.60 cents per gallon in December 1945. The average price of a selected bright stock at Oklahoma refineries remained at 22.75 cents per gallon for the first half of 1946, but increases in the latter half resulted in an average December price of 28.75 cents per gallon. The price of Bunker "C" oil at New York had dropped in the last quarter of 1945 to end the year at $1.51 per barrel. This price continued through January and February 1946. After small gains in March and April, the price did not change until July. The average for August was $1.97 per barrel, but this was followed by a slight decline in September to $1.92. The price remained at this level for the last 4 months of 1946.

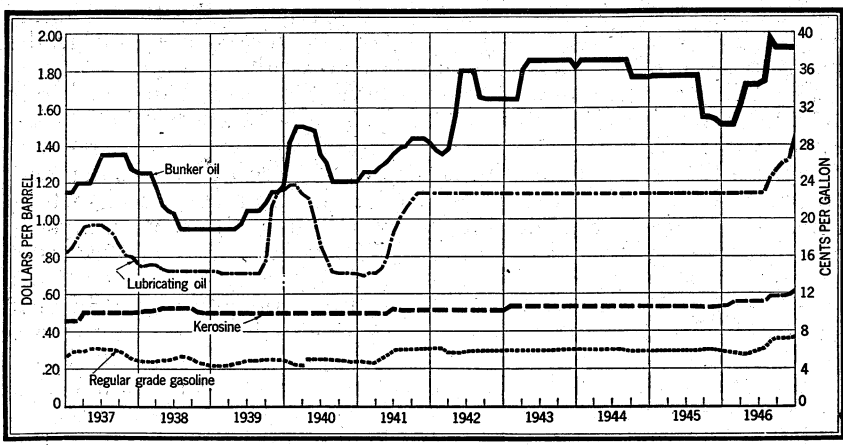

FIGURE 7.—Prices of Bunker "C" oil at New York, bright stock at Oklahoma refineries, tank-wagon prices of kerosine at Chicago, and Regular Grade gasoline at refineries in Oklahoma, 1937–46, by months.

Petroleum refinery capacity in the United States, January 1, 1942–47

Year	Number of refineries				Capacity (barrels per day)			
	Operating	Shut down	Building	Total	Operating	Shut down	Building	Total
1942	430	92	1	523	4,496,843	459,756	43,400	4,999,999
1943	386	85	1	472	4,409,013	492,998	195,100	5,097,111
1944	384	68		452	4,709,382	383,641	118,270	5,211,293
1945	380	33	1	414	5,077,690	223,463	36,075	5,337,228
1946	364	29	1	394	5,086,165	229,691	53,100	5,368,956
1947	361	38		399	5,336,399	233,083	162,200	5,731,682

AVIATION GASOLINE

Aviation gasoline is discussed separately because of special interest in this type of fuel, but all aviation-gasoline statistics are included in the statistics of total motor fuel and gasoline.

The total demand for aviation-grade gasoline in 1946 amounted to 15,199,000 barrels or only 10 percent of the demand in 1945 and 8 percent of the wartime peak demand in 1944. In addition to the decline of 136 million barrels in demand, there was a marked change in the demand for aviation gasoline by grades. The total demand for 100-octane gasoline in 1946 was only 4.6 percent of the 1945 demand for this grade, while the demand for other finished aviation grades was 48 percent of the 1945 demand for comparable grades.

The daily production of all grades of aviation gasoline dropped from 537,000 barrels in 1944 to 418,000 barrels in 1945 and to 70,000 barrels in 1946. This represents a production decrease of 83 percent in 1946 over 1945, compared with a drop of 90 percent in total demand. The variations in the percentage declines in production and in total demand are accounted for chiefly by the quantities of unfinished grades transferred to other products. This transfer item of 10,932,000 barrels was slightly smaller than the 1945 transfers of 11,162,000 barrels, but it represents 43 percent of the total production in 1946 compared with 7 percent of the 1945 production. When the war ended, the daily average aviation-gasoline production capacity in the United States amounted to about 600,000 barrels, compared with a postwar demand of less than 50,000 barrels. With this excess capacity available and confronted with a shortage of lead for the production of antiknock compounds, some refiners continued to produce aviation components and used the material in their automotive gasolines. A large part of the remaining capacity to produce aviation grades has been incorporated as parts of refineries producing automotive gasoline and other products.

Exports of all grades of aviation gasoline in 1946 totaled 6,299 barrels daily compared with a daily average of 93,471 barrels in 1945 and 156,148 barrels in 1944. The 1946 average was about the same as the average for the postwar portion of 1945 and about one-third of the export demand in 1941.

Salient statistics of aviation gasoline in the United States, 1945–46, by months

[Thousands of barrels]

1945	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1945	1944
Production:														
100-octane and above	14,731	13,673	15,644	15,531	16,525	15,332	15,364	12,454	3,566	970	278	147	124,215	[1] 136,130
Other grades	3,181	3,366	3,563	2,508	2,663	1,914	3,176	715	409	1,831	2,366	2,488	28,180	60,253
Transfers out	363	348	426	683	298	372	472	1,275	2,929	1,314	1,336	1,346	11,162	3,943
Exports	4,575	4,490	6,035	7,351	4,907	3,567	1,652	521	141	187	388	303	34,117	[2] 57,150
Stocks:														
100-octane and above	6,242	7,858	7,407	4,943	5,998	6,576	7,722	7,904	2,822	2,029	1,626	1,450	1,450	5,096
Other grades	10,180	10,599	10,943	9,739	9,434	8,674	9,183	7,290	3,691	3,385	3,517	3,822	3,822	10,050
Domestic demand: All grades	11,698	10,166	12,853	13,673	13,233	13,489	14,761	13,084	9,586	2,399	1,191	857	116,990	132,628
Total demand by grades:														
100-octane and above	13,580	12,055	16,094	17,989	15,470	14,753	14,216	12,172	8,638	1,733	676	298	127,674	134,140
Other finished	2,072	2,011	2,096	2,260	1,872	1,869	1,653	1,137	807	721	686	709	17,893	50,216
Components	621	590	698	775	798	434	544	296	282	132	217	153	5,540	5,422

1946 [3]	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1946	1945
Production:														
100-octane and above	470	263	197	283	485	460	577	469	496	417	550	675	5,342	124,215
Other grades	2,036	1,441	1,871	1,613	1,662	1,676	1,693	1,919	1,680	1,773	1,392	1,314	20,070	28,180
Transfers out	748	793	1,641	685	906	1,023	999	1,086	976	642	627	806	10,932	11,162
Exports	93	135	371	129	198	234	126	251	274	121	221	146	2,299	34,117
Stocks:														
100-octane and above	1,724	1,811	1,330	1,728	1,796	1,823	1,875	1,782	1,836	1,666	1,635	1,472	1,472	1,450
Other grades	3,784	3,740	3,376	3,225	3,197	3,080	2,882	2,769	2,647	2,946	3,107	3,081	3,081	3,822
Domestic demand: All grades	1,429	733	901	835	1,003	969	1,291	1,257	994	1,298	964	1,226	12,900	116,990
Total demand by grades:														
100-octane and above	621	263	501	243	399	429	537	525	445	582	585	695	5,825	127,674
Other finished	747	591	694	644	738	719	821	888	740	754	581	659	8,576	17,893
Components	154	14	77	77	64	55	59	95	83	83	19	18	798	5,540

[1] Includes some 98 and 99 octane.

[2] Exports of 80–87 octane aviation gasoline (Census classification—medium octane aviation) have not been included for 1944, since the only available figures include indeterminate amounts of automotive gasoline.

[3] Subject to revision.

Domestic demand (including military purchases in continental United States) dropped from 117 million barrels in 1945 to 13 million in 1946. Since most of the military requirements in 1946 were supplied from inventories in the custody of the armed forces, the 13-million-barrel demand, for the most part, represented purchases for use in commercial and private planes. However, this may not represent the entire fuel demand for private and commercial aircraft, since it is believed that some of the smaller planes are using automotive types of gasoline. If most of the military stocks are depleted by the middle of 1947, statistics for the latter half of the year should furnish a good indication of the normal current demand for aviation grades of gasoline.

MOTOR FUEL

The total demand for motor fuel in 1946 declined only 4 million barrels from the 1945 wartime peak despite a very sharp postwar drop in exports. This 1946 demand for 780,222,000 barrels of motor fuel was 47 million barrels greater than the 1944 demand and almost 86 million barrels above the prewar high in 1941. Since the aviation-grade portion of total motor-fuel demand dropped almost 136 million barrels from 1945 to 1946, the indicated increase for grades other than aviation was about 132 million barrels. This increase in civilian consumption offset the declines in export demand and in military liftings.

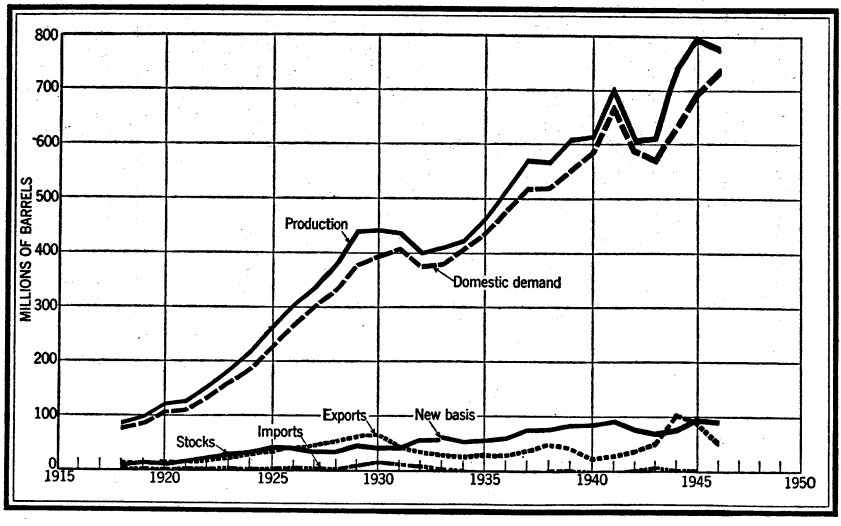

FIGURE 8.—Trends of production, domestic demand, exports, imports, and stocks of motor fuel in the United States, 1918–46.

Salient statistics of motor fuel in the United States in 1945, by months

[Thousands of barrels]

	1945						
	January	February	March	April	May	June	July
Production:							
Refinery gasoline:							
Cracked	34,262	32,255	34,655	33,177	34,427	34,263	35,696
Straight-run	24,267	23,733	25,037	24,553	27,006	24,644	28,457
Natural gasoline, etc	9,664	8,813	9,584	9,319	9,768	9,341	9,578
Less L. P. G. sales and transfers of cycle products [1]	1,884	1,677	1,696	1,653	1,724	1,569	1,521
Benzol	240	240	240	240	240	240	240
Total production	66,549	63,364	67,820	65,636	69,717	66,919	72,450
Daily average	2,147	2,263	2,188	2,188	2,249	2,231	2,337
Imports	141	201	110	87	299	352	142
Exports	9,718	7,655	12,359	12,561	11,680	9,903	6,436
Daily average	313	273	399	419	377	330	208
Stocks, end of period:							
Finished gasoline	78,877	85,473	85,654	79,653	77,151	74,089	74,460
Natural gasoline	4,160	4,618	4,644	4,783	4,873	4,723	4,338
Total stocks	83,037	90,091	90,298	84,436	82,024	78,812	78,798
Domestic demand	52,008	48,856	55,364	59,024	60,748	60,580	66,170
Daily average	1,678	1,745	1,786	1,967	1,960	2,019	2,135

	1945—Continued						1944
	August	September	October	November	December	Total	
Production:							
Refinery gasoline:							
Cracked	34,829	29,307	29,918	34,496	34,504	401,789	385,567
Straight-run	29,263	23,600	23,141	24,761	23,885	302,347	269,944
Natural gasoline, etc	9,472	8,390	9,088	9,295	9,692	112,004	100,046
Less L. P. G. sales and transfers of cycle products [1]	1,529	1,482	1,811	1,972	2,308	20,826	18,617
Benzol	240	240	240	240	240	2,880	2,400
Total production	72,275	60,055	60,576	66,820	66,013	798,194	739,340
Daily average	2,331	2,002	1,954	2,227	2,129	2,187	2,020
Imports	202	69	105	99		1,807	3,148
Exports	2,899	4,439	2,449	2,958	5,002	88,059	100,537
Daily average	94	148	79	99	161	241	275
Stocks, end of period:							
Finished gasoline	74,270	65,489	68,039	78,091	89,360	89,360	73,622
Natural gasoline	4,048	3,985	3,959	4,325	4,322	4,322	4,451
Total stocks	78,318	69,474	71,998	82,416	93,682	93,682	78,073
Domestic demand	70,058	64,529	55,708	53,543	49,745	696,333	632,482
Daily average	2,260	2,151	1,797	1,785	1,605	1,908	1,728

[1] Includes L. P. G. sales for fuel and chemical uses.

Salient statistics of motor fuel in the United States in 1946, by months

[Thousands of barrels]

	1946 [1]						
	January	February	March	April	May	June	July
Production:							
Refinery gasoline:							
Cracked	31,067	27,388	29,910	30,573	32,945	31,445	33,921
Straight-run	23,234	20,915	24,385	23,216	24,668	25,260	26,000
Natural gasoline, etc	9,882	9,011	9,323	9,073	9,379	9,351	9,408
Less L. P. G. sales and transfers of cycle products [2]	2,297	2,062	1,959	1,852	1,951	1,861	2,034
Benzol	240	240	240	150	150	150	150
Total production	62,126	55,492	61,899	61,160	65,191	64,345	67,445
Daily average	2,004	1,982	1,997	2,039	2,103	2,145	2,176
Imports							
Exports	5,473	4,616	5,390	3,533	3,038	2,860	2,752
Daily average	177	165	174	118	98	95	89
Stocks, end of period:							
Finished gasoline	94,115	96,293	95,186	90,444	85,801	83,726	79,384
Natural gasoline	5,034	5,843	6,658	6,982	7,004	7,343	7,334
Total stocks	99,149	102,136	101,844	97,426	92,805	91,069	86,718
Domestic demand	51,186	47,889	56,801	62,045	66,774	63,221	69,044
Daily average	1,651	1,710	1,832	2,068	2,154	2,107	2,227

	1946 [1]—Continued						1945
	August	September	October	November	December	Total	
Production:							
Refinery gasoline:							
Cracked	35,346	33,530	34,452	34,024	35,607	390,208	401,789
Straight-run	26,733	25,384	25,155	24,612	25,780	295,342	302,347
Natural gasoline, etc	9,671	9,424	10,125	10,005	10,501	115,153	112,004
Less L. P. G. sales and transfers of cycle products [2]	2,193	2,204	2,577	2,719	3,010	26,719	20,826
Benzol	150	150	150	150	150	2,070	2,880
Total production	69,707	66,284	67,305	66,072	69,028	776,054	798,194
Daily average	2,249	2,209	2,171	2,202	2,227	2,126	2,187
Imports					1	1	1,807
Exports	3,948	3,936	2,675	3,230	3,938	45,289	88,059
Daily average	127	131	86	108	127	124	241
Stocks, end of period:							
Finished gasoline	78,833	78,848	77,628	79,980	84,534	84,534	89,360
Natural gasoline	6,943	7,060	6,312	5,487	4,981	4,981	4,322
Total stocks	85,776	85,908	83,940	85,467	89,515	89,515	93,682
Domestic demand	66,701	62,216	66,598	61,315	61,043	734,333	696,333
Daily average	2,152	2,074	2,148	2,044	1,969	2,013	1,908

[1] Subject to revision.
[2] Includes L. P. G. sales for fuel and chemical uses.

Production.—The total production of motor fuel in 1946 was 776,054,000 barrels compared with a revised total for 1945 of 798,194,000 barrels. The portion of the 1946 total produced from crude oil amounted to 685,550,000 barrels, comprising 390,208,000 barrels of cracked gasoline and 295,342,000 barrels of straight run. The net contribution from natural gasoline and cycle plants (after transfers and sales of liquefied gases for fuel and chemical purposes are deducted) was 88,434,000 barrels. The remaining 2,070,000 barrels was benzol. A break-down of production by quarters indicates a daily

Production of gasoline in the United States in 1946, by methods of manufacture, districts, and months [1]

[Thousands of barrels]

Method and district	January	February	March	April	May	June	July	August	September	October	November	December	Total
Cracked:													
East Coast	5,121	4,392	4,649	4,969	5,263	4,946	5,652	5,790	5,836	5,713	5,678	6,237	64,246
Appalachian	1,316	1,239	1,350	1,237	1,363	1,271	1,304	1,484	1,278	1,351	1,431	1,461	16,085
Indiana, Illinois, Kentucky, etc	5,831	5,376	5,498	6,098	6,446	5,879	6,454	6,582	6,351	6,815	6,616	6,864	74,810
Oklahoma, Kansas, Missouri, etc	2,637	2,478	2,614	2,555	3,039	3,124	3,275	3,274	2,903	2,841	2,882	3,082	34,704
Texas Inland	1,633	1,425	1,648	1,510	1,631	1,692	1,822	1,852	1,691	1,866	1,836	1,834	20,440
Texas Gulf Coast	7,488	6,198	7,162	7,185	7,407	7,314	8,084	7,728	7,624	7,882	7,598	8,420	90,090
Louisiana Gulf Coast	1,859	1,306	1,693	2,157	2,124	1,968	1,989	2,320	2,199	2,343	2,344	2,261	24,563
Arkansas and Louisiana Inland	326	214	224	247	265	225	235	273	235	282	284	240	3,050
Rocky Mountain	831	843	841	744	973	760	871	1,074	1,030	899	868	758	10,492
California and Washington	4,025	3,917	4,231	3,871	4,434	4,266	4,235	4,969	4,383	4,460	4,487	4,450	51,728
Total cracked	31,067	27,388	29,910	30,573	32,945	31,445	33,921	35,346	33,530	34,452	34,024	35,607	390,208
Percent yield [2]	22.2	21.0	20.7	21.9	22.2	21.7	22.5	23.5	23.1	23.5	24.2	24.0	22.5
Straight-run:													
East Coast	2,337	2,158	2,626	2,427	2,664	2,501	2,491	2,648	2,502	2,628	2,349	2,545	29,876
Appalachian	835	802	820	666	761	776	733	923	705	774	722	807	9,324
Indiana, Illinois, Kentucky, etc	4,497	4,175	4,744	4,764	4,836	5,020	5,135	5,322	5,250	5,317	4,967	4,805	58,832
Oklahoma, Kansas, Missouri, etc	2,596	2,325	2,518	2,404	2,545	2,587	2,601	2,651	2,729	2,660	2,470	2,718	30,804
Texas Inland	1,265	1,032	1,206	1,206	1,337	1,417	1,472	1,745	1,624	1,645	1,493	1,511	16,953
Texas Gulf Coast	5,965	5,630	6,350	5,906	6,169	6,156	6,165	6,241	5,680	5,394	5,726	6,208	71,590
Louisiana Gulf Coast	1,779	1,387	1,798	1,507	1,644	1,863	1,966	2,171	2,044	2,059	2,115	2,052	22,385
Arkansas, Louisiana Inland, and Mississippi	284	281	282	227	256	358	330	367	344	358	350	388	3,825
Rocky Mountain	737	653	835	722	794	877	899	943	873	840	926	964	10,063
California and Washington	2,939	2,472	3,206	3,387	3,662	3,705	4,208	3,722	3,633	3,480	3,494	3,782	41,690
Total straight-run	23,234	20,915	24,385	23,216	24,668	25,260	26,000	26,733	25,384	25,155	24,612	25,780	295,342
Percent yield [2]	16.6	16.1	16.9	16.6	16.6	17.4	17.3	17.7	17.5	17.1	17.5	17.4	17.1
Total production, including natural gasoline blended at refineries:													
East Coast	7,535	6,636	7,340	7,444	8,026	7,521	8,181	8,577	8,428	8,493	8,204	8,918	95,303
Appalachian	2,208	2,085	2,205	1,933	2,155	2,080	2,065	2,450	2,039	2,177	2,198	2,319	25,914
Indiana, Illinois, Kentucky, etc	10,821	10,032	10,697	11,353	11,806	11,499	12,271	12,606	12,279	12,793	12,277	12,288	140,722
Oklahoma, Kansas, Missouri, etc	5,749	5,162	5,519	5,302	5,930	6,071	6,283	6,395	6,156	6,159	5,972	6,404	71,102
Texas Inland	3,485	3,298	3,744	3,607	3,974	4,042	4,213	4,610	4,219	4,382	4,374	4,423	48,371
Texas Gulf Coast	15,067	12,844	14,639	14,229	14,696	14,634	15,457	15,404	14,647	14,779	14,911	16,015	177,322
Louisiana Gulf Coast	3,848	2,828	3,612	3,860	3,971	4,048	4,153	4,710	4,492	4,620	4,719	4,620	49,481
Arkansas, Louisiana Inland, and Mississippi	781	646	624	554	611	679	656	740	698	769	749	739	8,246
Rocky Mountain	1,668	1,576	1,760	1,537	1,835	1,698	1,839	2,101	1,985	1,852	1,900	1,827	21,578
California and Washington	8,176	7,644	8,774	8,457	9,478	9,373	10,032	10,260	9,361	9,606	9,564	9,647	110,372
Total: 1946	59,338	52,751	58,914	58,276	62,482	61,645	65,150	67,853	64,304	65,630	64,868	67,200	748,411
1945	64,909	61,445	65,830	63,807	67,547	64,972	70,704	70,328	57,988	58,542	64,682	63,706	774,460

[1] Subject to revision.

[2] Based on crude runs to stills.

average production in the last quarter that exceeds the daily average for the year by 3.5 percent. The highest rate of production came in August, when the daily average was 2,249,000 barrels compared with 2,337,000 barrels daily in July 1945. However, the 1945 peak month was in a period just before the end of the war, when the military demand was very large and when daily production included almost 600,000 barrels of aviation gasoline.

Yields.—The average refinery yields of gasoline from crude petroleum dropped from 40.9 percent in 1945 to 39.6 percent in 1946. In view of actual demand in the first quarter of 1946, stocks of gasoline were relatively high at the end of 1945 and stocks of fuel oil and kerosine were low, necessitating readjustment of percentage yields in the early part of 1946. This accounts for the drop in yields of gasoline from an average of 41.9 percent in November and December 1945 to 38.8 percent in January 1946 and 37.1 in February. The average yield for any month in 1946 did not exceed 40 percent until August, and the highest yield came in November—41.7 percent.

Domestic Demand.—The domestic demand for motor fuel in 1946 (including military purchases in continental United States) increased to 734,833,000 barrels to set another all-time high. This was 38,500,000 barrels or 5.5 percent above the previous peak, reached in 1945, and 67,328,000 barrels above the prewar record in 1941. During the period from 1920 through 1940, the average yearly increase in domestic demand for motor fuel was about 24 million barrels. The year 1940 is taken for the close of the prewar period, since wartime expansions contributed largely to the abnormal increase in 1941. Domestic demand for motor fuel in 1940 was a little above 589 million barrels. If this total for 1940 is projected, using the prewar average yearly increase of 24 million barrels, the indicated domestic demand for 1946 would be 733 million barrels compared with an actual demand of 735 million barrels.

A break-down of the 1946 domestic demand by quarters indicates a relative increase in winter consumption compared with summer demand. For 1935–41 the average daily demand in the first quarter of each year was 17 percent below the average for that year, but the daily average in the first quarter of 1946 was only 14 percent below the annual average. In the same prewar period the fourth-quarter average was less than 0.5 percent above the yearly average compared with a fourth-quarter demand in 1946 that was 2 percent above the daily average for the year. The daily average for the summer quarters in the prewar period was 8 percent above the yearly average, but in 1946 the demand in this season was only 6 percent above the daily average for the year.

Production and Consumption, by States.—The refinery production of gasoline in 1946 amounted to 748,411,000 barrels compared with 774,460,000 barrels in 1945. Production in Texas dropped from 234.7 million barrels in 1945 to 225.7 million in 1946, but this still represented 30 percent of the total production by all refineries in the United States. The California production (including some production in Washington) dropped from 121.1 million barrels in 1945 to 110.4 million in 1946 or to about the level of production in

1944. The greatest increase in production was recorded for Pennsylvania with a gain from 57.0 million barrels in 1945 to 60.7 million in 1946.

Production and consumption of gasoline in the United States, 1944–46, by States

[Thousands of barrels]

State	1944		1945		1946 [1]	
	Production	Consumption [2]	Production	Consumption [2]	Production	Consumption [2]
Alabama	(3)	6,264	(3)	7,318	(3)	9,374
Arizona		3,078		3,168		4,084
Arkansas	3,116	4,268	3,668	5,117	4,112	6,516
California	[4] 109,867	57,565	[4] 121,094	65,760	[4] 110,372	75,374
Colorado	2,514	7,073	2,568	7,061	2,716	8,051
Connecticut		6,505		7,143		9,156
Delaware		1,195		1,308		1,666
District of Columbia		2,589		2,811		3,441
Florida		9,083		10,184		13,611
Georgia	[5] 7,518	8,979	[5] 8,268	9,947	[5] 6,635	13,461
Idaho	(6)	2,278	(6)	2,636	(6)	3,408
Illinois	[7] 53,145	27,770	[7] 54,582	30,315	[7] 53,896	39,141
Indiana	42,818	16,640	43,825	18,039	44,874	21,158
Iowa		12,496		14,239		17,858
Kansas	[8] 32,413	10,528	[8] 33,353	11,757	[8] 34,639	14,202
Kentucky	[9] 7,861	7,019	[9] 9,440	8,729	[9] 8,178	9,766
Louisiana	[3] 43,894	7,287	[3] 52,457	7,519	[3] 53,615	8,927
Maine		3,113		3,466		4,395
Maryland	(5)	7,033	(5)	7,831	(5)	9,056
Massachusetts	[10] 6,333	12,812	[10] 5,679	14,270	[10] 2,865	17,862
Michigan	11,103	25,806	10,381	27,896	8,998	34,650
Minnesota	(7)	11,029	(7)	12,671	(7)	16,783
Mississippi	(3)	4,899	(3)	5,608	(3)	7,264
Missouri	(8)	12,640	(8)	14,521	(8)	18,983
Montana	4,158	2,769	3,973	3,162	4,242	4,172
Nebraska	(8)	5,608	(8)	6,330	(8)	7,796
Nevada		1,466		1,233		1,424
New Hampshire		1,588		1,822		2,469
New Jersey	29,473	16,473	31,871	17,811	28,615	22,267
New Mexico	1,876	2,639	2,010	3,096	1,905	3,914
New York	8,371	33,155	9,632	35,500	9,792	46,328
North Carolina		9,721		11,372		15,154
North Dakota		4,074		4,544		5,436
Ohio	36,001	32,520	34,691	33,411	35,125	38,761
Oklahoma	35,876	11,379	39,393	13,619	36,463	12,492
Oregon		6,264		6,662		9,066
Pennsylvania	51,430	26,964	56,993	30,083	60,662	39,561
Rhode Island	(10)	2,873	(10)	2,965	(10)	3,184
South Carolina	(5)	5,208	(5)	5,628	(5)	7,426
South Dakota		3,182		4,013		4,737
Tennessee	(9)	7,951	(9)	9,113	(9)	11,827
Texas	220,758	97,718	234,703	98,313	225,693	53,908
Utah	(6)	2,490	(6)	2,865	(6)	3,573
Vermont		1,071		1,300		1,840
Virginia		10,317		11,002		13,365
Washington	(4)	8,989	(4)	9,891	(4)	12,383
West Virginia	2,757	3,799	2,566	4,508	2,299	6,117
Wisconsin	(7)	11,520	(7)	13,853	(7)	17,594
Wyoming	[6] 11,436	1,687	[6] 13,313	1,793	[6] 12,715	2,253
Total	722,718	579,374	774,460	633,203	748,411	715,234

[1] Subject to revision.
[2] American Petroleum Institute.
[3] Alabama and Mississippi included with Louisiana.
[4] Washington included with California.
[5] Maryland and South Carolina included with Georgia.
[6] Idaho and Utah included with Wyoming.
[7] Minnesota and Wisconsin included with Illinois.
[8] Missouri and Nebraska included with Kansas.
[9] Tennessee included with Kentucky.
[10] Rhode Island included with Massachusetts.

In the war period it was extremely difficult to compute the demand for gasoline by States because, in some instances, sales to the Government within a State represented gasoline that ultimately was moved to another State or was shipped abroad. Since military purchases in 1946 accounted for only a small percentage of the total domestic demand, the State totals for that year furnish a better indication of consumption by States than did the totals in the war years. If the consumption by districts in 1940 (based on State totals) is compared with the consumption in 1946, a relative shift in demand is indicated. In 1940 the consumption in district 1 (east coast States) represented 36 percent of the United States total, but in 1946 the demand in this district had dropped to 32 percent of the total. In the Midwest and North Central States the 1940 demand was 39.4 percent of the total compared with 37.9 percent in 1946. However, the refinery production of gasoline in this area had declined relatively from 33.4 percent of the total in 1940 to 29.7 percent in 1946. This change may be represented by a ratio of district production to district demand. The refinery production of gasoline in this district in 1940 amounted to 88.1 percent of the total consumption within the district, but in 1946 the production had dropped to 81.9 percent of demand. This decline in the ratio of production to demand required additional shipments into these States from the Gulf Coast area. District 5 (Arizona, California, Nevada, Oregon, and Washington) had the greatest relative increase in consumption between 1940 and 1946. The demand in this area in 1946 was 14.3 percent of the total for all States compared with 11.3 percent in 1940. The relative increase in the Gulf Coast States was from 10.3 percent of the total in 1940 to 12.6 percent in 1946, and the increase in the Rocky Mountain district was from 2.8 percent in 1940 to 3.0 percent in 1946.

Methods of Distribution.—The total quantity of motor fuel delivered from pipe lines in 1946 amounted to 218,756,000 barrels compared with 282,115,000 barrels in 1945. However, the 1945 total included operations of the 20-inch war-emergency products line for 8 months. The 1946 total represents about 29 percent of the total refinery production of gasoline compared with 36 percent of production delivered from pipe lines in 1945. Part of the wartime pipe-line movement was replaced by an increase in the normal shipments from the Gulf coast to the east coast. The tanker and barge shipments of gasoline from Louisiana and Texas to east coast ports (including the west coast of Florida) increased from 48,793,000 barrels in 1945 to 123,967,000 barrels in 1946. Barge liftings of gasoline in Arkansas, Louisiana, and Texas for Mississippi River ports increased from 20.7 million barrels in 1945 to 29.1 million in 1946. Several products pipe lines were under construction in 1946 and others were projected for 1947 to further serve some of the high-demand inland areas.

Stocks.—Stocks of finished gasoline at the close of 1945 totaled 89,360,000 barrels, or an all-time record for finished-gasoline inventories at the end of a year. This high level was due to abnormal stock increases in the last quarter of 1945. Since these stocks were relatively higher than the inventories of kerosine and fuel oils, a shift of yields was necessary to produce fuels to meet the demands in the first quarter of 1946. Stocks of finished gasoline increased only 5,826,000 barrels in this quarter. This increase, combined with a decline of 11,460,000 barrels in the second quarter, a drop of 4,878,000 barrels in the third, and a gain of 5,686,000 barrels in the fourth, produced a net decrease of 4,826,000 barrels for the year. Stocks of unfinished gasoline varied slightly over a million barrels between the high and low points in 1946 and closed at 8,208,000 barrels compared with 8,316,000 barrels on December 31, 1945. Stocks of natural gasoline and cycle products amounted to 4,322,000 barrels at the end of 1945 and increased each month in the first half of 1946 to reach 7,343,000 barrels at the end of June. Since the decline in the last half of the year was less than the gain in the first 6 months, stocks of light products at the end of 1946 were 659,000 barrels above the 1945 closing inventories.

Shipments of motor fuel by pipe lines in the United States in 1946, by months

[Thousands of barrels]

	1946						
	January	February	March	April	May	June	July
Motor fuel turned into lines	14,317	13,832	16,281	17,509	19,452	18,888	20,181
Motor fuel delivered from lines	15,593	13,066	16,128	18,293	19,498	18,801	20,687
Shortage	37	18	61	48	54	69	97
Stocks in lines and working tanks, end of month	9,290	10,038	10,130	9,298	9,198	9,216	8,613

	1946—Continued						1945
	August	September	October	November	December	Total	
Motor fuel turned into lines	19,657	19,819	20,263	19,233	18,742	218,174	281,551
Motor fuel delivered from lines	19,489	19,566	20,710	19,176	17,749	218,756	282,115
Shortage	89	65	53	64	106	761	957
Stocks in lines and working tanks, end of month	8,692	8,880	8,380	8,373	9,260	9,260	10,603

Stocks may be expressed in terms of days' supply by dividing the stocks at the end of a month by the daily average total demand for the succeeding month. Using this basis, the stocks of finished gasoline on December 31 represented 43.4 days' supply at the end of 1946 compared with 48.9 at the end of 1945.

All total stocks include inventories of gasoline held at refineries and bulk terminals and by pipe lines but do not include stocks in the smaller distribution plants or stocks that have passed into the custody of the armed forces.

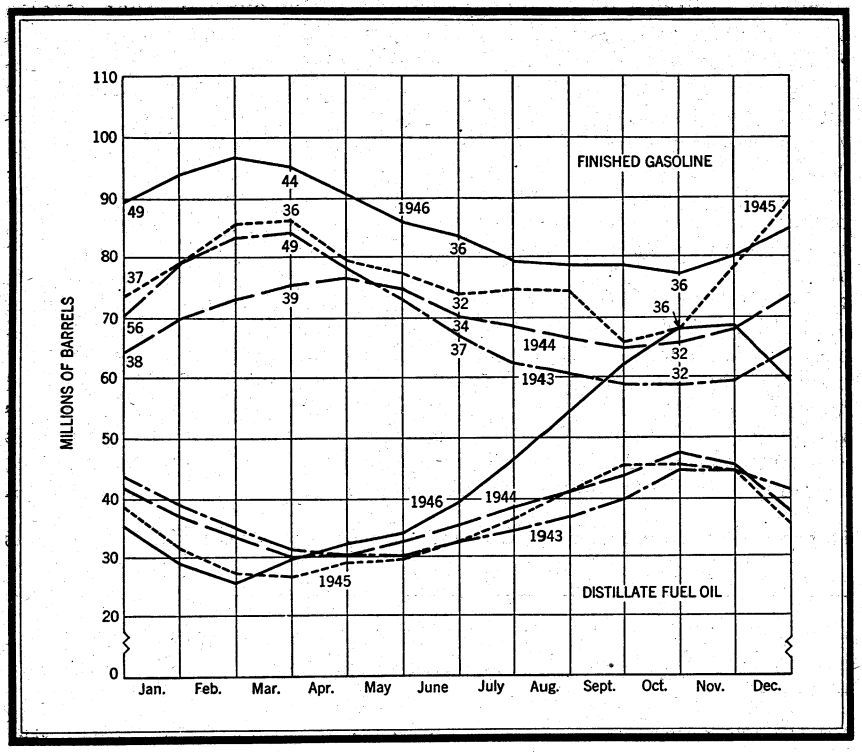

FIGURE 9.—Stocks of finished gasoline in the United States 1943–46, by months, with figures representing days' supply at certain periods; also stocks of distillate fuel oil, 1943–46, by months.

Days' supply of motor fuel on hand in the United States at end of month, 1944–46 [1]

Month	1944			1945			1946 [2]		
	Finished gasoline	Natural gasoline	Total motor fuel	Finished gasoline	Natural gasoline	Total motor fuel	Finished gasoline	Natural gasoline	Total motor fuel
January	38.4	2.4	40.8	39.1	2.0	41.1	50.2	2.7	52.9
February	39.2	2.3	41.5	39.1	2.1	41.2	48.0	2.9	50.9
March	39.4	2.2	41.6	35.9	1.9	37.8	43.6	3.0	46.6
April	37.3	2.1	39.4	34.1	2.0	36.1	40.2	3.1	43.3
May	33.9	2.0	35.9	32.8	2.1	34.9	38.9	3.2	42.1
June	33.7	2.1	35.8	31.6	2.0	33.6	36.1	3.2	39.3
July	32.1	2.0	34.1	31.6	1.8	33.4	34.8	3.2	38.0
August	30.5	1.9	32.4	32.3	1.8	34.1	35.8	3.1	38.9
September	31.3	2.0	33.3	34.9	2.1	37.0	35.3	3.1	38.4
October	31.7	2.0	33.7	36.1	2.1	38.2	36.1	2.9	39.0
November	35.2	2.2	37.4	44.2	2.4	46.6	38.2	2.6	40.8
December	36.9	2.1	39.0	48.9	2.4	51.3	43.4	2.6	46.0

[1] Stocks divided by the daily average total demand (domestic demand plus exports) for succeeding month.
[2] Subject to revision.

Stocks of gasoline in the United States in 1946, by districts and months

[Thousands of barrels]

District	January 31	February 28	March 31	April 30	May 31	June 30	July 31	August 31	September 30	October 31	November 30	December 31
Finished gasoline [1]												
East Coast	20,844	22,181	21,768	22,420	21,485	21,543	20,873	21,414	20,530	19,085	18,488	18,613
Appalachian	3,531	3,683	3,823	3,433	3,222	3,098	2,917	2,780	2,661	2,770	2,733	3,122
Indiana, Illinois, Kentucky, etc	21,303	23,053	23,237	21,060	18,875	17,646	15,443	15,019	15,358	14,786	15,457	17,208
Oklahoma, Kansas, and Missouri	9,372	9,694	9,709	8,196	7,830	7,561	7,285	7,464	7,876	7,815	7,821	8,403
Texas Inland	2,698	2,691	2,689	2,441	2,415	2,268	1,972	2,122	2,220	2,631	2,992	3,188
Texas Gulf Coast	14,079	13,103	12,776	11,957	12,100	12,275	11,671	10,511	10,205	10,741	11,233	11,845
Louisiana Gulf Coast	5,015	4,224	4,174	3,776	3,344	3,581	3,811	4,128	4,291	4,353	4,292	4,825
Arkansas and Louisiana Inland	2,037	2,001	1,775	1,829	1,625	1,495	1,702	1,380	1,563	1,371	1,709	1,670
Rocky Mountain	2,157	2,715	2,694	2,427	2,067	1,754	1,320	1,164	1,329	1,386	1,705	1,919
California	13,079	12,948	12,541	12,905	12,838	12,505	12,390	12,851	12,815	12,690	13,550	13,741
Total finished gasoline	94,115	96,293	95,186	90,444	85,801	83,726	79,384	78,833	78,848	77,628	79,980	84,534
Unfinished gasoline:												
East Coast	962	890	974	870	838	987	1,194	896	930	801	1,077	941
Appalachian	458	429	397	503	486	446	402	412	424	435	409	380
Indiana, Illinois, Kentucky, etc	784	751	1,013	793	841	829	861	794	931	730	652	624
Oklahoma, Kansas, and Missouri	372	350	285	323	312	340	300	308	326	364	312	280
Texas Inland	490	492	382	385	424	416	363	344	321	309	311	324
Texas Gulf Coast	1,980	2,369	2,596	2,396	2,270	2,375	2,547	2,440	2,429	2,444	2,483	2,416
Louisiana Gulf Coast	286	408	490	403	377	390	450	447	365	384	336	323
Arkansas and Louisiana Inland	1	1	1	21	25	24	4	2	3	1	2	2
Rocky Mountain	158	149	190	176	215	247	197	138	161	137	128	146
California	2,788	2,704	2,647	2,430	2,371	2,191	2,076	2,131	2,283	2,719	2,897	2,772
Total unfinished gasoline	8,279	8,543	8,975	8,300	8,159	8,245	8,394	7,912	8,173	8,324	8,607	8,208
Total finished and unfinished gasoline:												
East Coast	21,806	23,071	22,742	23,290	22,323	22,530	22,067	22,310	21,460	19,886	19,565	19,554
Appalachian	3,989	4,112	4,220	3,936	3,708	3,544	3,319	3,192	3,085	3,205	3,142	3,502
Indiana, Illinois, Kentucky, etc	22,087	23,804	24,250	21,853	19,716	18,475	16,304	15,813	16,289	15,516	16,109	17,832
Oklahoma, Kansas, and Missouri	9,744	10,044	9,994	8,519	8,142	7,901	7,585	7,772	8,202	8,179	8,133	8,683
Texas Inland	3,188	3,183	3,071	2,826	2,839	2,684	2,335	2,466	2,541	2,940	3,303	3,512
Texas Gulf Coast	16,059	15,472	15,372	14,353	14,370	14,650	14,218	12,951	12,634	13,185	13,716	14,261
Louisiana Gulf Coast	5,301	4,632	4,664	4,179	3,721	3,971	4,261	4,575	4,656	4,737	4,628	5,148
Arkansas and Louisiana Inland	2,038	2,002	1,776	1,850	1,650	1,519	1,706	1,382	1,566	1,372	1,711	1,672
Rocky Mountain	2,315	2,864	2,884	2,603	2,282	2,001	1,517	1,302	1,490	1,523	1,833	2,065
California	15,867	15,652	15,188	15,335	15,209	14,696	14,466	14,982	15,098	15,409	16,447	16,513
Total: 1946	102,394	104,836	104,161	98,744	93,960	91,971	87,778	86,745	87,021	85,952	88,587	92,742
1945	91,666	97,457	97,447	90,804	88,330	86,128	85,582	84,003	74,574	76,805	86,540	97,676

[1] Includes stocks of finished gasoline at refineries, bulk terminals, and in pipe lines.

Prices.—The general downward trend of gasoline prices in the last quarter of 1945 continued for several months in 1946 or until the first general increase in the price of crude petroleum. This crude price increase came on April 1 and amounted to 10 cents per barrel. However, the average monthly refinery price of Oklahoma gasoline did not exceed the December 1945 level until June, prior to the July crude price increase. From September to the year end gasoline prices increased gradually until the average Oklahoma refinery price in December 1946 was 1.44 cents per gallon above the average in December 1945. The average dealers' net price (exclusive of tax) in 50 representative cities in the United States furnishes an index of gasoline prices at the wholesale level. On January 1, 1947, this average price, according to the American Petroleum Institute, was 11.27 cents per gallon compared with 10.07 cents per gallon on January 1, 1946, an increase of 1.2 cents per gallon in 12 months. In the same series the average service-station price, including all taxes (price at the consumers' level) increased from 20.24 cents per gallon at the first of 1946 to 21.73 cents at the end of the year, a gain of 1.49 cents per gallon. Based on net prices (exclusive of tax) these increases represented percentage gains of 11.9 at the dealer level and 10.5 at the consumer level. In general, these percentage increases in the prices of gasoline were smaller than the percentage gain in the prices of all commodities as shown by the combined index of wholesale prices published by the United States Department of Labor. This index rose from 107.1 for December 1945 to 140.9 for December 1946.

The average local tax rate in the 50-city series remained at 0.05 cent per gallon in 1946, and the Federal tax rate continued at 1.50 cents per gallon. The average State tax was 4.50 cents per gallon on January 1, 1946, increased to 4.52 cents on March 1, and rose to 4.54 cents on July 1. The average of all taxes for the year in these 50 cities was 6.08 cents per gallon.

Average monthly prices of gasoline in the United States, 1945–46, in cents per gallon

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1945													
Monthly average at refineries in Oklahoma, 73–75 octane [1]	5.88	5.88	5.88	5.88	5.88	5.88	5.88	5.88	5.99	6.00	5.92	5.81	5.90
Average of 50 cities on 1st of month: [2]													
Dealers' net (ex. tax)	10.46	10.46	10.46	10.46	10.46	10.46	10.46	10.46	10.07	10.07	10.07	10.07	10.33
Service station (including State and local taxes only)	19.05	19.05	19.05	19.07	19.11	19.11	19.11	19.13	19.13	18.74	18.74	18.74	19.00
1946													
Monthly average at refineries in Oklahoma, 73–75 octane [1]	5.72	5.62	5.50	5.52	5.72	5.90	6.15	6.88	7.12	7.13	7.14	7.25	6.30
Average of 50 cities on 1st of month: [2]													
Dealers' net (ex. tax)	10.07	9.99	9.86	9.86	9.89	9.90	9.99	10.67	11.10	11.13	11.12	11.18	10.40
Service station (including State and local taxes only)	18.74	18.71	18.72	18.69	18.70	18.72	18.77	19.67	20.10	20.08	20.11	20.20	19.27

[1] National Petroleum News.
[2] American Petroleum Institute; compiled by The Texas Co.

Exports.—Exports of motor fuel (including shipments to noncontiguous Territories) averaged 124,000 barrels daily in 1946 compared with 275,000 barrels daily in 1944 and a daily average of 241,000 barrels in 1945. However, the exports in the first quarter of 1946 averaged 172,000 barrels daily, and the total for the 3-month period was about one-third of the total for the year. The daily average motor-fuel exports in the second, third, and fourth quarters were 104,000, 116,000, and 107,000 barrels, respectively. Countries receiving over 5 percent each of the 1946 motor-fuel exports from continental United States were: United Kingdom, 28 percent; France, 12 percent; and Canada, 10 percent. The combined shipments to all noncontiguous Territories were about 7.7 percent of the total.

KEROSINE AND RANGE OIL

The production of kerosine in 1946 was not only sufficient to satisfy an expanded domestic and export demand, but there was also enough made to add a considerable quantity to storage. No imports of kerosine were reported during the year.

Kerosine produced in 1946 totaled 104,385,000 barrels, another new record, and 29 percent over the 1945 output (81,024,000 barrels). The greatly increased production of kerosine in 1946 was due largely to a higher percentage yield (6.0 percent in 1946 compared with 4.7 percent in 1945) and to a lesser extent to increased runs of crude petroleum, the volume of which was only slightly (less than 1 percent) over the 1945 quantity. This is in contrast to what happened in 1945 when the gain in kerosine production was entirely the result of increased runs of crude at refineries, as there was no improvement in the percentage yield in that year. A higher percentage yield for kerosine became possible in 1946, as that for both motor fuel and residual fuel oil was lower.

All refinery areas except the Arkansas and Louisiana Inland district reported gains in the production of kerosine in 1946. The more important percentage increases were noted in the East Coast, Texas Gulf Coast, Louisiana Gulf Coast, and California refinery districts. The outstanding gain of the year was reported for the Texas Gulf Coast area, where the output of kerosine increased by 54 percent and the volume rose from 28 percent of the national total in 1945 to 34 percent in 1946. Other large increases in kerosine production were recorded for the Louisiana Gulf Coast district—a 31 percent gain—and for the East Coast district, where the 1946 total was about 29 percent over the comparative 1945 item. The Indiana-Illinois-Kentucky district produces about 15 percent of the national kerosine total, and there the 1946 output was 19 percent above that reported for 1945. It should be added that the Oklahoma-Kansas-Missouri group of States is also a source of relatively important quantities of kerosine and the production in the area increased by 13 percent in 1946 over 1945. Smaller amounts of kerosine are made in the other refining districts; however, the only one to show an outstanding gain was California, where the 1946 total was 36 percent over the 1945 production.

Salient statistics of kerosine in the United States, 1945–46, by months and districts

Month and district	Production (thousands of barrels)		Yield (percent)		Domestic demand (thousands of barrels)		Stocks, end of period (thousands of barrels)	
	1945	1946 [1]	1945	1946 [1]	1945	1946 [1]	1945	1946 [1]
By months:								
January	6,614	9,688	4.6	6.9	8,831	11,176	8,742	8,330
February	6,291	9,506	4.7	7.3	7,587	9,608	7,150	7,848
March	7,056	9,852	4.8	6.8	6,805	8,006	6,925	9,292
April	6,260	8,396	4.4	6.0	4,521	5,995	8,252	10,992
May	6,445	8,887	4.2	6.0	5,467	6,338	8,574	12,741
June	6,337	8,376	4.2	5.8	4,741	5,185	9,599	14,318
July	6,520	8,435	4.2	5.6	4,394	5,339	11,157	16,403
August	7,089	8,179	4.6	5.4	3,803	4,321	13,894	19,458
September	5,858	7,825	4.6	5.4	5,253	5,284	13,675	21,251
October	6,447	8,566	4.9	5.8	6,788	7,502	12,708	21,978
November	7,564	7,893	5.5	5.6	7,597	8,899	12,141	20,528
December	8,543	8,782	6.0	5.9	9,786	11,513	10,421	17,081
Total	81,024	104,385	4.7	6.0	75,573	89,166	10,421	17,081
By districts:								
East Coast	10,755	13,832	3.9	5.0	[2]	[2]	3,894	7,806
Appalachian	3,288	3,309	5.9	5.9			302	477
Indiana, Illinois, Kentucky, etc.	12,719	15,156	4.6	5.4			1,769	2,006
Oklahoma, Kansas, and Missouri	8,039	9,116	5.8	6.6			583	971
Texas Inland	4,626	4,673	5.5	5.9			237	402
Texas Gulf Coast	22,924	35,284	5.7	8.3			1,817	2,921
Louisiana Gulf Coast	12,178	15,954	12.3	13.2			999	1,436
Arkansas and Louisiana Inland	2,546	2,067	9.1	9.4			221	358
Rocky Mountain	1,117	1,136	2.4	2.4			103	106
California	2,832	3,858	0.9	1.4			496	598
Total	81,024	104,385	4.7	6.0	75,573	89,166	10,421	17,081

[1] Subject to revision.
[2] Figures not available.

Increases of 5 percent in the domestic demand for kerosine reported for both 1944 and 1945 jumped to an 18-percent gain in 1946, when indicated deliveries were 89,166,000 barrels compared with 75,573,000 in 1945. This expanded market for kerosine was also evident in early 1947, as the domestic demand in the first quarter was 14 percent above comparative 1946 requirements. The annual demand for kerosine cannot be presented by refinery districts, because data on shipments and receipts, as well as the imports and exports for each respective area, are not compiled.

Exports of kerosine have expanded noticeably in the past 2 years, as the 1946 total (8,559,000 barrels) was 39 percent over the corresponding foreign demand of 6,180,000 in 1945, which in turn was 26 percent above the 1944 level. The United Kingdom is credited with the larger share of the kerosine shipped out of the country; however, the quantity declined from 4,984,000 barrels in 1945 to 3,013,000 in 1946. Relatively less important quantities of kerosine go to many foreign countries; however, the 1946 totals for Canada, France, Sweden, the Netherlands, the Philippines, China, French Morocco, and Australia were well above 1945 requirements.

Stocks of kerosine, which dipped slightly in 1945, rose sharply in 1946, when the year-end total of 17,081,000 barrels was 64 percent above the 10,421,000 held in storage at the close of 1945. About 60 percent of kerosine stocks are reported at refineries, and these reserves increased by about 57 percent from 6,212,000 barrels in 1945

to 9,772,000 at the end of 1946, while supplies carried at bulk terminals rose from 4,209,000 barrels in 1945 to 7,309,000 in 1946, a 74-percent gain in contrast to a decline of over 20 percent in such stocks in 1945 compared with the closing inventory for 1944. The days of supply represented by kerosine held in storage at the year end dropped from 38 days for 1944 to 31 days for 1945; however, the greatly increased stocks for 1946 were sufficient for 41 days at the subsequent January rate of total demand.

All refinery districts, whether predominantly supply or consumption areas, showed increases in kerosine stocks in 1946. This differed from 1945 when, generally speaking, kerosine inventories piled up in producing districts due mainly to the lack of adequate transportation facilities and shrunk in areas of high consumer demand. Kerosine stocks reported for the East Coast district, a major market, doubled from 3,894,000 barrels at the end of 1945 to 7,806,000 for 1946. It should be added that the kerosine inventory for this important consuming area rose from 37 percent of the national total at the close of 1945 to a 46-percent share in 1946. Relatively large kerosine stocks are held in the Indiana-Illinois-Kentucky refinery district, and quantities there increased by 13 percent from 1,769,000 barrels in 1945 to 2,006,000 in December 1946; however, the relative amount of these reserves declined from 17 percent of the national total for kerosine in 1945 to 12 percent in 1946. About 17 percent of the kerosine is stored in the Texas Gulf Coast district, a supply area, and there the quantity increased by over 60 percent from 1,817,000 barrels in 1945 to 2,921,000 at the close of 1946. Kerosine held in the Louisiana Gulf Coast district, another supply area, rose from 999,000 barrels at the end of 1945 to 1,436,000 for 1946—a 44-percent gain. Relatively lesser amounts of kerosine stocks are reported from the remaining refinery districts, and the respective quantities all showed gains in 1946.

Sales of kerosine in the United States, 1944–45, by regions, States, and uses [1]

[Thousands of barrels]

Region [2] and State	Sold as range oil		Tractor fuel		All other uses		Total	
	1944	1945	1944	1945	1944	1945	1944	1945
Pacific Coast:								
California	278	381	22	24	1,584	1,286	1,884	1,691
Oregon	29	32	2	-------	138	160	169	192
Washington	29	32	1	-------	173	226	203	258
Arizona	22	27	-------	1	159	113	181	141
Nevada	3	3	-------	-------	14	13	17	16
Rocky Mountain:								
Idaho	6	7	13	12	32	41	51	60
Montana	29	30	49	51	64	56	142	137
Wyoming	11	10	24	22	25	27	60	59
Utah	7	6	5	7	15	18	27	31
Colorado	28	40	57	60	97	81	182	181
New Mexico	73	89	38	51	66	84	177	224
North Central:								
North Dakota	71	97	164	184	89	94	324	375
South Dakota	77	103	150	149	85	91	312	343
Minnesota	357	381	144	237	467	450	968	1,068
Nebraska	226	260	124	143	230	211	580	614
Iowa	302	347	731	831	605	624	1,638	1,802
Wisconsin	277	300	135	384	449	474	861	1,158

See footnotes at end of table.

Sales of kerosine in the United States, 1944–45, by regions, States, and uses [1]—Con.

[Thousands of barrels]

Region [2] and State	Sold as range oil		Tractor fuel		All other uses		Total	
	1944	1945	1944	1945	1944	1945	1944	1945
North Central—Continued								
Illinois	1,803	1,822	352	451	1,673	1,772	3,828	4,045
Indiana	260	314	210	256	1,070	1,123	1,540	1,693
Michigan	365	429	188	467	861	820	1,414	1,716
Ohio	480	559	171	197	623	552	1,274	1,308
Kentucky	121	133	103	112	530	605	754	850
Tennessee	285	386	168	178	751	728	1,204	1,292
South Central:								
Missouri	561	557	170	174	782	817	1,513	1,548
Kansas	140	179	326	274	340	353	806	806
Texas	922	1,092	1,078	788	2,521	2,628	4,521	4,508
Oklahoma	224	274	301	251	662	712	1,187	1,237
Arkansas	330	369	248	230	648	625	1,226	1,224
Louisiana	166	203	202	224	835	827	1,203	1,254
Mississippi	82	96	160	165	467	503	709	764
Alabama	166	186	119	118	516	540	801	844
New England:								
Maine	1,360	1,402	4	5	43	48	1,407	1,455
New Hampshire	785	839	1	1	9	11	795	851
Vermont	401	442	1	2	52	62	454	506
Massachusetts	10,577	10,785	------	------	399	433	10,976	11,218
Rhode Island	1,967	2,048	3	3	53	65	2,023	2,116
Connecticut	3,530	3,651	------	------	78	95	3,608	3,746
Middle Atlantic:								
New York	6,888	6,994	82	76	1,007	1,099	7,977	8,169
New Jersey	3,433	3,545	75	52	991	1,040	4,499	4,637
Pennsylvania	1,026	1,354	108	95	1,114	1,172	2,248	2,621
Delaware	103	132	------	1	59	64	162	197
Maryland	683	691	19	9	443	550	1,145	1,250
District of Columbia	107	125	1	1	72	88	180	214
South Atlantic:								
Virginia	273	419	21	19	686	667	980	1,105
West Virginia	36	41	10	11	123	172	169	224
North Carolina	739	858	85	109	659	681	1,483	1,648
South Carolina	275	320	71	79	514	566	860	965
Georgia	394	394	92	104	501	580	987	1,078
Florida	710	756	115	139	680	642	1,505	1,537
Total	41,017	43,540	6,143	6,747	24,054	24,689	71,214	74,976

[1] Figures for 1946 by States not yet available.
[2] States are grouped according to petroleum-marketing territories rather than to conventional geographic regions.

Sales of kerosine in1945 (74,976,000 barrels) were 5 percent over the 1944 total (71,214,000) according to the annual survey of the Bureau of Mines, and repeated a similar percentage gain recorded for 1944. All marketing areas of the country reported a higher volume of kerosine deliveries in 1945, except the Pacific Coast region, where the turn-over declined for a second consecutive year. Sales of kerosine in the East Coast area, where nearly 60 percent of the national demand is located, increased by 5 percent from 41,458,000 barrels in 1944 to 43,537,000 in 1945. The larger share of these totals was reported from the New England States, and sales there of 19,892,000 barrels in 1945 were 3 percent over the 1944 total of 19,263,000 barrels. The Middle Atlantic States constitute a second important market for kerosine, and deliveries in the area increased by over 5 percent from 16,211,000 barrels in 1944 to 17,088,000 in 1945. Sales of kerosine in the remaining section of the Atlantic Coast area—the South Atlantic States—are relatively less important in volume; however, the 1945 quantity for the area was 10 percent above the 1944 demand. Dealers distrib-

uted 16,264,000 barrels of kerosine in the North Central States in 1945—an 11-percent gain over 1944 (14,697,000 barrels). Considerable quantities of kerosine are also consumed in the South Central States, and the increase in sales there in 1945 was about 2 percent. Very little kerosine is sold in the Rocky Mountain area; however, there was an 8-percent gain in demand for 1945, while deliveries on the Pacific coast dropped from 2,454,000 barrels in 1944 to 2,298,000 in 1945.

Sales of range oil in the United States, 1943–45, by States [1]

[Thousand of barrels]

State	1943	1944	1945	
			Total	Percent of total
Massachusetts	10,251	10,993	11,227	22.0
New York	6,494	7,013	7,122	13.9
Connecticut	3,608	3,918	3,995	7.8
New Jersey	3,085	3,504	3,756	7.4
Illinois	3,281	3,139	3,345	6.5
Rhode Island	1,917	2,042	2,132	4.2
Maine	1,355	1,435	1,522	3.0
Pennsylvania	891	1,055	1,365	2.7
Michigan	1,025	1,101	1,226	2.4
Texas	865	931	1,111	2.2
Iowa	878	964	1,035	2.0
Wisconsin	856	864	949	1.9
Minnesota	750	858	926	1.8
North Carolina	809	761	885	1.7
New Hampshire	835	808	873	1.7
Missouri	700	727	867	1.7
Florida	719	735	804	1.6
Maryland	666	690	696	1.4
Ohio	634	562	669	1.3
Indiana	553	582	604	1.2
Other States	3,925	4,954	5,912	11.6
Total	44,097	47,636	51,021	100.0

[1] Figures for 1946, by States, not yet available.

Nearly three-fifths of all kerosine sales are reported as range oil, and quantities sold for this purpose increased by 6 percent from 41,017,000 barrels in 1944 to 43,540,000 in 1945. Slightly less than 10 percent of all kerosine deliveries is used as tractor fuel, and the demand went from 6,143,000 barrels in 1944 to 6,747,000 in 1945. Sales of kerosine for various sundry uses, such as lamp fuel, insecticides, orchard heating, weed burning, tobacco curing, etc., rose from 24,054,000 barrels in 1944 to 24,689,000 in 1945.

The survey covering sales of kerosine, by uses, in 1946 is incomplete at present; however, it is estimated that deliveries for range fuel probably totaled 53,500,000 barrels, while tractor fuel (7,650,000 barrels) and all other uses (28,016,000 barrels) made up the balance of the indicated demand of 89,166,000 barrels noted in the monthly reports of the Bureau of Mines.

Representative kerosine prices were higher in 1946 than in 1945. The average quotation for 41°–43° gravity, water-white kerosine at refineries in Oklahoma—4.33 cents a gallon in December 1945—rose to 4.48 cents in January 1946 and then to 4.88 cents in February. The increase in January of ½ cent a gallon was allowed by the Office

Monthly average prices of kerosine in the United States, 1945–46

[Platt's Oil Price Handbook]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1945													
41°–43° gravity w. w. kerosine at refineries, Oklahoma cents per gallon	4.38	4.38	4.38	4.38	4.38	4.38	4.93	4.38	4.38	4.38	4.37	4.33	4.37
Kerosine (and/or No. 1 fuel oil) at New York Harbor do	7.10	7.10	7.10	7.10	7.10	7.10	7.10	7.10	5.60	5.60	5.60	5.78	6.61
Kerosine, tank-wagon at Chicago do	10.60	10.60	10.60	10.60	10.60	10.60	10.60	10.48	10.30	10.30	10.56	10.60	10.54
Kerosine, tank-wagon at New York City do	10.30	10.30	10.30	10.30	10.30	10.30	10.30	10.30	8.80	8.80	8.80	8.98	9.82
1946													
41°–43° gravity, w. w. kerosine at refineries, Oklahoma do	4.48	4.88	4.88	4.88	4.88	4.88	4.94	5.43	5.39	5.38	5.41	5.77	5.10
Kerosine (and/or No. 1 fuel oil) at New York Harbor do	6.10	6.10	6.10	6.10	6.10	6.10	6.15	6.72	6.70	6.70	6.70	6.99	6.38
Kerosine, tank-wagon at Chicago do	10.66	11.10	11.10	11.10	11.10	11.10	11.14	11.70	11.70	11.70	11.85	12.20	11.37
Kerosine, tank-wagon at New York City do	9.30	9.30	9.30	9.30	9.30	9.30	9.41	10.00	10.00	10.00	10.00	10.28	9.62

of Price Administration so as to force more kerosine and other light fuel oils into the market. The price remained at that level through June and then edged upward through several changes to a December average of 5.77 cents a gallon, which brought the weighted average for 1946 to 5.10 cents a gallon compared with 4.37 cents for 1945. The average price of kerosine, including No. 1 fuel oil at New York Harbor, was maintained at 7.10 cents a gallon for the first 8 months of 1945 and then dropped to 5.60 cents a gallon when the War Shipping Administration, by its Rate Order 378, removed all surcharges on basic tanker rates. The quotation moved upward to an average of 5.78 cents for December 1945, and the weighted average for the year was 6.61 cents a gallon. A price of 6.10 cents a gallon was maintained through June 1946; then quotations rose by several stages to 7.00 cents late in December, making the average quotation for the year 6.38 cents a gallon.

The tank-wagon price of kerosine at Chicago was held at 10.60 cents a gallon throughout 1945, except for a dip to 10.30 cents from August 20–November 5 that lowered the weighted average for the year to 10.54 cents a gallon. There were mark-ups in January, July, and November 1946 to a final price of 12.20 cents a gallon and an average of 11.37 cents for the year. The dropping of surcharges in tanker rates in September 1945 forced down the tank-wagon price in New York from 10.30 cents a gallon to 8.80 cents. A quotation of 9.30 cents a gallon was established on December 21, and the average for the year was 9.82 cents a gallon. The price of 9.30 cents was maintained until July 27, 1946, when there was an advance to 10.00 cents a gallon. A second increase to 10.30 cents was posted on December 3 and the weighted average for all of 1946 was 9.62 cents a gallon.

DISTILLATE FUEL OIL

Substantially increased production of distillate fuel oil, including Diesel fuel, together with slightly higher transfers and imports and lower exports, enabled oil companies not only to satisfy an increased domestic demand in 1946 but to add a large surplus to storage. These salient factors differed from those prevailing in 1945, when a slightly inflated production combined with lower transfers and imports was not sufficient to meet a higher demand and a draft on stocks was necessary to make up the difference. The domestic demand of 242,965,000 barrels of distillate fuel oil in 1946 was 7.5 percent over 1945 requirements of 226,084,000 barrels, which in turn were 8 percent above the 1944 total. Foreign shipments of light-grade fuel oils have fallen since the ending of the war, as the 1946 total of 29,353,000 barrels was 12 percent below the 1945 item of 33,496,000 barrels, which in turn was 23 percent under the 1944 demand.

A review of the domestic demand in 1946, by quarters, shows that peak requirements of 74,618,000 barrels came in the first 3 months when the need for heating oils was a factor and that the total for the period was 9 percent over the corresponding item of 68,295,000 barrels in 1945. Usually the demand in the final quarter of any year is somewhat below the total for the first 3 months of the same year; however, in 1946 requirements of 73,691,000 barrels in the fourth quarter nearly equaled the indicated demand in the opening period, and fur-

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Salient statistics of distillate fuel oil in the United States, 1945–46, by months and districts

[Thousands of barrels]

Month and district	Production		Yield (percent)		Transfers [1]				Imports		Exports		Domestic demand		Stocks, end of period	
					East of California		California									
	1945	1946 [2]	1945	1946 [2]	1945	1946 [2]	1945	1946 [2]	1945	1946 [2]	1945	1946 [2]	1945	1946 [2]	1945	1946 [2]
By months:																
January	20,556	24,390	14.2	17.4	292	253	-------	-------	6	582	2,429	2,540	25,063	29,473	31,695	28,990
February	20,267	23,047	15.0	17.7	241	220	-------	-------	218	480	1,760	1,885	23,451	25,341	27,210	25,511
March	20,934	25,298	14.3	17.5	266	243	-------	-------	649	528	2,549	1,854	19,781	19,804	26,729	29,922
April	20,443	23,181	14.3	16.6	253	379	-------	-------	758	251	3,119	3,606	15,916	18,063	29,148	32,064
May	21,941	23,348	14.4	15.7	259	243	-------	-------	647	674	4,127	4,147	18,357	18,297	29,511	33,885
June	21,891	23,320	14.6	16.1	257	242	-------	-------	417	342	4,913	4,115	14,723	14,850	32,440	38,824
July	22,099	24,589	14.3	16.3	273	257	-------	-------	192	605	3,358	2,738	15,370	15,098	36,276	46,439
August	21,740	23,703	14.2	15.7	255	265	-------	-------	264	507	2,182	3,018	15,108	13,828	41,245	54,068
September	19,204	23,877	15.0	16.4	231	250	-------	-------	217	408	1,604	2,064	14,234	14,520	45,059	62,019
October	19,009	24,432	14.5	16.6	223	248	-------	-------	239	330	2,619	1,028	16,432	18,131	45,479	67,870
November	19,964	23,741	14.4	16.9	249	257	-------	-------	596	264	2,648	877	19,078	23,110	44,562	68,145
December	21,176	24,970	14.9	16.9	245	266	3	-------	551	170	2,188	1,481	28,571	32,450	35,778	59,620
Total	249,224	287,896	14.5	16.6	3,044	3,123	3	-------	4,754	5,141	33,496	29,353	226,084	242,965	35,778	59,620
By districts:																
East Coast	50,243	55,252	18.4	20.0	-------	-------	-------	-------							10,515	20,613
Appalachian	6,101	6,015	10.9	10.8	-------	-------	-------	-------							745	568
Indiana, Illinois, Kentucky, etc	34,601	36,861	12.5	13.2	480	447	-------	-------							5,773	6,114
Oklahoma, Kansas, and Missouri	20,500	21,457	14.7	15.5	899	760	-------	-------							1,839	2,536
Texas Inland	6,146	5,362	7.3	6.8	924	1,041	-------	-------							362	492
Texas Gulf Coast	73,677	86,469	18.3	20.4	364	449	-------	-------	[3]	[3]	[3]	[3]	[3]	[3]	6,027	12,150
Louisiana Gulf Coast	19,710	25,590	19.8	21.1	131	160	-------	-------							1,766	3,942
Arkansas and Louisiana Inland	3,409	3,131	12.2	14.3	44	29	-------	-------							469	512
Rocky Mountain	5,135	6,609	11.2	13.8	202	237	-------	-------							414	452
California	29,702	41,150	9.5	14.4	-------	-------	3	-------							7,868	12,241
Total	249,224	287,896	14.5	16.6	3,044	3,123	3	-------	4,754	5,141	33,496	29,353	226,084	242,965	35,778	59,620

[1] Figures represent crude oil used as fuel on pipe lines.
[2] Subject to revision.
[3] Figures not available.

thermore, the total was 15 percent above the comparative item of 64,081,000 barrels for 1945. It was warmer in the fourth quarter of 1946 than in the same months of 1945; besides, comparative prices for light fuel oils were higher in 1946 so these negative factors could not have inflated the volume of demand. However, greatly increased shipments of domestic oil burners in the second half of 1946, many of which were installed and operating at the end of the year, were probably the main reason for the expanded market. Delayed stocking of light fuel oils by both dealers and consumers was evidently another factor, as it is noticed that the demand in the third quarter of 1946 of 43,446,000 barrels is 3 percent below the corresponding total for 1945—44,712,000 barrels. The domestic demand for distillate fuel oil in the second quarter of 1946—51,210,000 barrels—is only 4.5 percent above the comparative item of 48,996,000 barrels for 1945 or well below the 7.5 percent gain indicated for the entire year. The fast-growing requirements for light heating oils and Diesel fuel is strongly evident in the opening quarter of 1947, when the domestic demand (96,260,000 barrels) was 29 percent above the total in the same 3 months of 1946.

A definite break-down of the domestic demand for distillate fuel oils, including Diesel fuel, in 1946 is not available, as the annual survey covering sales of fuel oil by the Bureau of Mines is incomplete at this time. There are, however, some monthly data and other information upon which estimates of the several demands for light fuel oils can be made. The records of the Interstate Commerce Commission show that the railroads purchased 13,314,000 barrels of Diesel fuel in 1946; and it is believed that the total demand, including other distillate fuel oils, probably was 16,500,000 barrels for the year. Monthly releases of the Bureau of the Census, United States Department of Commerce, indicate that 5,466,000 barrels of Diesel fuel were loaded at continental ports of the country on vessels engaged in foreign trade. This item does not cover other light fuel oils, including Diesel fuel, sold to boats operating in coastal or inland waters, and it estimated that the total vessel demand for distillate grades reached 13,000,000 barrels in 1946.

Sales of distillate fuel oil [1] in the United States, 1941–45, by uses [2]

[Thousands of barrels]

Use	1941	1942	1943	1944	1945
Railroads	4,945	6,488	8,608	10,627	14,458
Ships' bunkers (including tankers)	10,957	8,900	11,069	13,187	14,130
Gas and electric power plants	5,152	5,704	5,954	5,837	6,824
Smelters, mines, and manufacturing industries	10,363	12,617	15,125	16,953	19,071
Heating oils	120,908	121,506	112,581	111,729	121,342
Fuel oil (No. 1) sold as range oil	4,449	4,978	5,876	6,619	7,481
U. S. Navy, Army, and Coast Guard	2,993	11,269	33,383	42,879	30,366
Oil-company fuel	1,116	1,064	884	981	1,128
Miscellaneous uses	12,456	14,287	14,232	15,060	16,825
Total United States	173,339	186,813	207,712	[3] 223,872	[3] 231,625
Exports and shipments to noncontiguous Territories	16,925	21,575	24,957	43,491	33,496
Total	190,264	208,388	232,669	267,363	265,121

[1] Includes Diesel fuel.
[2] Figures for 1946 not yet available.
[3] These totals involve some duplication owing to rehandling of fuel oil initially sold to the Government.

No figures are available showing the demand for light fuel oils by gas and electric power utilities; however, statistics released by the Federal Power Commission indicate a sharp upward trend in the demand for all grades of fuel oils in 1946, and it is possible that the light-fuel-oil total for both the gas and electric power industries expanded to 9,900,000 barrels for the year. The index of manufacturing for 1946 as computed by the Federal Reserve Board was 177compared with 214 in 1945. However, these indices reflect the need for fuels of all kinds by the manufacturing industries and not that for fuel oil alone. It is believed that the demand by industrial plants for distillate fuel oil, including Diesel fuel, continued to rise in 1946 to about 21,000,000 barrels, as all rationing regulations were off for the full year; burner equipment was more readily available, and besides there were interruptions in the coal supply due to strikes.

The number of domestic oil burners in use in 1946 indicates a demand of 138,000,000 barrels of light heating oil for the year, and it is believed that there was an additional market for approximately 9,000,000 barrels of No. 1 fuel oil for use in range burners. This latter quantity, plus an estimate of 53,500,000 barrels of kerosine sold for range fuel, makes a total of 62,500,000 barrels delivered for range-burner fuel in 1946.

Oil companies probably used about 1,200,000 barrels of distillate fuel oils in their operations in 1946, while the balance of the indicated domestic demand—34,365,000 barrels—must be credited to military and miscellaneous uses.

The changing demand for distillate fuel oils by various uses is shown graphically for 1937–45 in figure 10. All light fuel oils, Diesel fuel, and kerosine sold as range fuel are included.

A downward trend in exports of distillate fuel oils noticed in 1945 continued into 1946, when the total of 29,353,000 barrels for the year was 12 percent below foreign shipments of 33,496,000 barrels in 1945. Viewed in another way, 13 percent of the light-fuel-oil supply was credited to exports in 1945, while the proportion dropped to 10 percent in 1946. Exports of distillate fuel oil to the United Kingdom were drastically reduced from 26,913,000 barrels in 1945 to 14,399,000 in 1946, while shipments to some other countries gained noticeably; however, the quantities involved were not relatively important. Exports of light fuel oils to Canada, which showed a loss in 1945, rose to 1,649,000 barrels in 1946 or double the 1945 total of 826,000 barrels. Consignments of distillate grades of fuel oil to Mexico were 418,000 barrels in 1946 compared with 242,000 in 1945. Efforts in postwar reconstruction in Europe are reflected in American shipments of light fuel oil to the following countries: France, 699,000 barrels in 1945 and 2,234,000 in 1946; Sweden, 671,000 barrels in 1945 and 1,627,000 in 1946; Denmark, 99,000 barrels in 1945 and 720,000 in 1946; Netherlands, 48,000 barrels in 1945 and 744,000 in 1946; and Spain, nothing in 1945 and 225,000 in 1946. A sharp expansion in exports of distillate fuel oils to U. S. S. R. in recent years leveled off in 1946 to 1,075,000 barrels compared with 1,052,000 in 1945.

The production of distillate fuel oil in 1946—287,896,000 barrels—was about 16 percent over the 1945 total of 249,224,000 barrels, and this increase compares with a 4-percent gain for 1945 and a 13-percent expansion in 1944. It can be added that the distillate fuel oils pro-

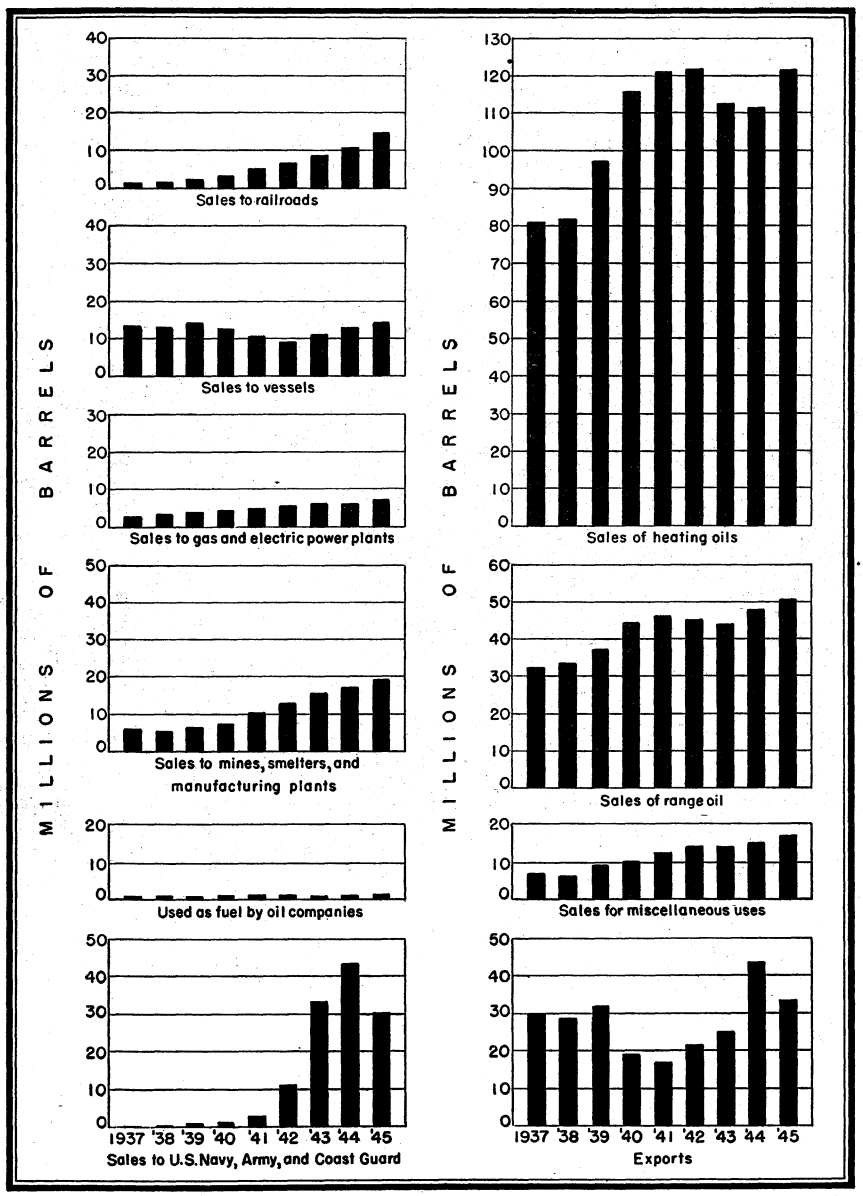

FIGURE 10.—Sales of distillate fuel oil, including Diesel fuel, and range oil in the United States, 1937–45, by uses.

duced in 1946 were sufficient to satisfy 97.2 percent of the total demand (domestic and foreign) including gains in year-end stocks, compared with a 96.0-percent share in 1945. The percentage yield for distillate fuel oils jumped from less than 15 percent in recent years (14.5 percent in 1945) to 16.6 percent in 1946. This gain in the percentage output of light fuel oils, was, however, at the expense of lower yields for both residual fuel oil (24.9-percent yield in 1946 compared with 27.3 percent in 1945) and motor fuel produced from crude petroleum—39.6 percent in 1946 against 40.9 percent in 1945.

Sales of distillate fuel oil [1] in the United States, 1941–45, by regions and States [2]

[Thousands of barrels]

Region [3] and State	1941	1942	1943	1944	1945
Pacific Coast:					
Washington	3,717	4,598	5,654	5,933	6,586
Oregon	2,043	2,541	2,850	2,927	3,219
California	11,029	12,820	17,552	18,032	16,753
Arizona	656	872	774	878	961
Nevada	476	635	582	715	715
Rocky Mountain:					
Idaho	293	519	433	569	597
Montana	477	502	532	989	1,745
Wyoming	258	317	308	744	1,231
Utah	216	424	487	571	703
Colorado	548	646	741	1,015	1,171
New Mexico	198	227	403	522	563
North Central:					
North Dakota	637	661	550	482	662
South Dakota	695	737	648	618	691
Minnesota	6,034	6,543	5,867	5,290	5,658
Nebraska	2,117	2,155	2,010	2,561	2,578
Iowa	3,197	4,039	3,758	3,528	4,633
Wisconsin	5,543	5,885	5,572	4,986	5,074
Illinois	16,530	17,641	16,177	16,056	17,174
Indiana	2,757	2,958	2,804	2,927	3,086
Michigan	6,369	7,385	6,799	6,535	7,337
Ohio	2,658	3,247	3,543	3,586	4,414
Kentucky	786	1,031	1,051	1,067	1,172
Tennessee	618	800	1,095	1,168	1,331
South Central:					
Missouri	5,431	5,499	4,814	4,900	5,364
Kansas	1,021	1,299	1,539	1,615	2,115
Texas	3,304	6,422	18,595	23,551	19,724
Oklahoma	390	476	666	662	676
Arkansas	810	884	1,092	1,152	1,134
Louisiana	2,154	2,555	4,408	4,961	3,825
Mississippi	538	541	581	627	631
Alabama	800	991	1,286	1,375	1,255
New England:					
Maine	1,410	1,190	1,062	1,012	1,149
New Hampshire	1,431	1,229	938	820	879
Vermont	677	607	523	575	626
Massachusetts	13,087	10,976	10,190	10,460	11,640
Rhode Island	2,694	2,659	2,377	2,440	3,049
Connecticut	5,629	5,279	5,452	5,789	6,210
Middle Atlantic:					
New York	29,454	28,880	29,458	27,770	29,954
New Jersey	15,932	17,635	19,017	25,535	25,964
Pennsylvania	8,379	8,432	10,225	12,925	12,618
Delaware	457	516	650	803	512
Maryland	3,221	3,628	3,795	4,026	4,976
District of Columbia	2,079	2,203	1,907	1,786	1,863
South Atlantic:					
Virginia	1,857	2,157	2,966	3,535	2,612
West Virginia	275	300	391	314	338
North Carolina	965	1,119	1,227	1,252	1,584
South Carolina	505	663	824	924	917
Georgia	1,016	1,043	900	959	1,298
Florida	1,971	2,447	2,639	2,405	2,658
Total	173,339	186,813	207,712	[4] 223,872	[4] 231,625

[1] Includes Diesel fuel oil.

[2] Figures for 1946 not yet available.

[3] States are grouped according to petroleum-marketing territories rather than to conventional geographic regions.

[4] These totals involve some duplication owing to rehandling of fuel oil initially sold to the Government.

All refinery districts of the country reported increased production of distillate fuel oils in 1946, except the Appalachian, Texas Inland, and the Arkansas and Louisiana Inland areas, where the quantities produced are relatively small. Refineries operating in the Texas Gulf Coast district produce nearly a third of the distillate fuel oils, and there the total for 1946—86,469,000 barrels—was 17 percent above the 1945 total (73,677,000 barrels). This larger volume of light fuel oil for the area was the result of both a 5-percent increase in crude runs and a higher percentage yield—20.4 percent in 1946 compared with 18.3 percent in 1945. The East Coast district is the source of about 20 percent of the distillate fuel oils produced in the country, and the output expanded by 10 percent from 50,243,000 barrels in 1945 to 55,252,000 in 1946. The crude runs in the district in 1946 were only 1 percent over the 1945 throughput, so most of the expanded light-fuel-oil production must be credited to a stepped-up yield—20.0 percent in 1946 compared with 18.4 percent in 1945.

The Indiana-Illinois-Kentucky refinery district produced a 14-percent share of all distillate fuel oils in 1945, but only 13 percent of the total in 1946; however, the quantity rose from 34,601,000 barrels in 1945 to 36,861,000 in 1946—about a 7-percent gain. Here a higher yield—13.2 percent in 1946 against 12.5 percent in 1945—was probably the weightier factor in the higher production, as the runs in 1946 were only slightly above those in 1945. The outstanding increase in light-fuel-oil production in 1946 is found in the California refinery district, where the output jumped 39 percent from 29,702,000 barrels in 1945 to 41,150,000 in 1946; furthermore, the percentage share of the national total for the area went from 12 percent in 1945 to over 14 percent in 1946. This greater production of distillates in the California area was realized, even though crude runs to stills were lower by 9 percent in 1946, consequently the gain must be credited entirely to a much higher yield—14.4 percent in 1946 compared with 9.5 percent in 1945. This improved yield for the light grades of fuel oil was possible in 1946, as that for residuals declined sharply from 47.5 percent in 1945 to 41.8 percent in 1946 and furthermore the percentage yield for motor fuel made from crude petroleum was down fractionately.

An appreciable amount of light fuel oil originates in the Louisiana Gulf Coast refinery district—8 percent of the national total in 1945 and 9 percent in 1946—and the output for the area increased from 19,710,000 barrels in 1945 to 25,590,000 in 1946—a 30-percent gain compared with a 27-percent rise in 1945. A higher yield—21.1 percent in 1946 against 19.8 percent in 1945—and stepped-up crude runs (22 percent over 1945), repeating similar favorable factors prevailing in the district in 1945, made possible the greater production of distillate fuel oils in 1946. Production of distillates in the Oklahoma-Kansas-Missouri district in 1946 (21,457,000 barrels) was about 5 percent over the 1945 quantity (20,500,000 barrels). This small gain was entirely the result of a better yield—15.5 percent in 1946 compared with 14.7 percent in 1945—as crude runs for these States dropped slightly.

The remaining refinery districts do not produce large amounts of distillate fuel oil. The quantity reported for the Rocky Mountain area showed a big gain (29 percent) in 1946, while declines were indicated for the Appalachian (1 percent down), the Texas Inland (13

percent down), and the Arkansas and Louisiana Inland (8 percent down) districts.

Light crude petroleum used as fuel by pipe lines is reported as "transfers" to the distillate fuel oils; the quantities involved were 3,123,000 barrels in 1946 and 3,044,000 in 1945. Such "transfers" supply about 1 percent of the total demand for all light fuel oils. The larger shares of these items were credited to the Oklahoma-Kansas-Missouri and the Texas Inland refinery districts, and none at all was reported for the East Coast and Appalachian areas.

Imports of distillate fuel oils into continental United States declined from a wartime peak of 15,269,000 barrels in 1943 to 4,754,000 in 1945; however, there was an increase of 8 percent in 1946 to 5,141,000 barrels. Less than 2 percent of the total demand for light fuel oils is made up of supplies received from foreign countries. The larger share of the imported distillate fuel oil comes from Curaçao; however, several other countries, such as Venezuela, Trinidad, Mexico, and Canada, are credited with lesser amounts. Receipts of some light fuel oils from Saudi Arabia appear in the import statistics for the first time in 1946. This was an item of 113,000 barrels received in the San Francisco customs district, according to the Bureau of the Census, United States Department of Commerce.

Stocks of distillate fuel oils, which have dropped each year since 1941, turned upward to a record volume of 59,620,000 barrels for the year end of 1946, a quantity 67 percent above the comparative item of 35,778,000 for 1945. The light fuel oil in storage at the close of 1946 was equivalent to a 51-day supply at the subsequent January rate of total demand; this compares with a 35-day quantity available at the end of 1945 and 43 days for 1944. In 1945 the pressure for light fuel oils was so great that 1 percent of the total demand (2,555,000 barrels) was satisfied by supplies withdrawn from storage. Conditions were greatly changed in 1946, as 8 percent of the available supply (23,842,000 barrels) was surplus over the year's demand and therefore was added to storage.

Both refinery and bulk-terminal stocks of light fuel oils showed outstanding increases in 1946. Quantities reported as stored at refineries rose from 23,842,000 barrels at the end of 1945 to 38,708,000 for 1946—a 62-percent gain compared with a 5-percent shrinkage of these same stocks in 1945 and 10 percent in 1944. Distillate inventories at bulk terminals—20,912,000 barrels at the close of 1946—were 75 percent over the 1945 quantity (11,936,000 barrels), and this gain is in contrast to losses of 10 percent in 1945 and 5 percent in 1944 for these grades.

All refinery districts reported higher distillate-fuel-oil stocks at the end of 1946 compared with 1945 except the Appalachian area, where quantities held are relatively unimportant. Light-fuel-oil inventories nearly doubled or even more than doubled in several refinery districts in 1946. Supplies held in the important East Coast area jumped from 29 percent of the national total in 1945 to a 35-percent share in 1946, when the quantity at the end of the latter year (20,613,000 barrels) was 96 percent above the 1945 total (10,515,000 barrels). About a fifth of the light-fuel-oil stocks are found in the Texas Gulf Coast area, and there the total rose from 6,027,000 barrels in 1945 to 12,150,000 at the close of 1946. Quantities of distillates reported

from the Louisiana Gulf Coast region are relatively less in importance; however, they expanded from 1,766,000 barrels for 1945 to 3,942,000 in 1946.

The California refinery area reports a large inventory of distillate fuel oil (about one-fifth of the national total), and the volume of 12,241,000 barrels in December 1946 was about 56 percent over the 7,868,000 barrels held at the close of 1945. The quantity of light fuel oil stored in the Indiana-Illinois-Kentucky refinery district increased but slightly during 1946 (6,114,000 in December 1946 compared with 5,773,000 for 1945), and moreover the 1946 item represented only a 10-percent share of the national inventory compared with 16 percent at the end of 1945. Less than 5 percent of the distillate stocks are carried in the Oklahoma-Kansas-Missouri group of States; however, the total reported rose from 1,839,000 barrels in 1945 to 2,536,000 in 1946. Only small quantities of distillate-grade fuel oils are reported as held in the Appalachian, Texas Inland, Arkansas and Louisiana Inland, and Rocky Mountain refinery districts; and the year-end stocks all showed gains in 1946 over 1945, except for the Appalachian area.

There were no tanker movements of light fuel oil from California to eastern areas in 1945 or 1946. The West Coast marketing area (California, Oregon, Washington, Arizona, and Nevada) does, however, make some rail and truck shipments of distillates to other States, and the total covered in this trade was 870,000 barrels in 1946 compared with 636,000 in 1945 and 492,000 in 1944. The California refinery district also receives light fuel oils from other parts of the country, and these totaled 289,000 barrels in 1946 against 251,000 in 1945 and 275,000 in 1944.

Tanker shipments of distillate oil from the Gulf to the East Coast, which practically disappeared during the war years, shot up strongly in 1946 to a record total of 68,851,000 barrels compared with 28,175,000 in 1945. It should be added that the new level in this movement is well above similar prewar shipments, which reached a former "high" of 44,429,000 barrels in 1940. Texas is the source of the larger share (60,115,000 barrels in 1946 compared with 24,883,000 in 1945) of the light fuel oil moved in the Gulf-East Coast tanker traffic, while the balance (8,736,000 barrels in 1946 and 3,292,000 in 1945) originated in Louisiana.

There are some barge and tanker movements of distillate fuel oil from the Gulf Coast area to terminals on the Mississippi River; however, this traffic has varied greatly—from 2,881,000 barrels in 1944 to 4,352,000 in 1945, followed by a sharp drop to 1,879,000 barrels in 1946. Most of this light fuel oil is loaded at Louisiana ports; only a small fraction of it comes from Texas. Arkansas also ships some light fuel oils to points on the Mississippi River, and the volume of this trade has also shrunk drastically—from 3,398,000 barrels in 1944 to 2,980,000 in 1945 and down to 83,000 in 1946. These recent declines in the Mississippi River traffic reflect a change-over from wartime to normal peacetime conditions.

There were no changes in tanker rates in 1946 on No. 2 distillate fuel oil shipped from the Gulf to North Atlantic ports—not east of New York. A freight charge of 38 cents per barrel, effective October

15, 1945, was maintained throughout 1946. It should be added that the present transportation cost is actually figured at $2.85 a long ton (2,240 pounds) for all petroleum products; consequently the calculated rate per barrel varies with the average gravity of the different oils.

An upward trend in distillate-fuel-oil prices was evident in 1946 as crude oil and labor costs mounted and the demand for these fuels increased. The price of 3.63 cents a gallon for No. 2 Straw fuel oil at refineries in Oklahoma, dating from December 1942, was raised to 4.13 cents in January 1946. This advance of ½ cent a gallon was authorized by the Office of Price Administration on January 24 and was applicable to kerosine and heating oils sold for domestic consumption in P. A. W. Districts 1, 2, and 3. The increase in the price for these light products was intended to bring more of them into the market at the expense of an oversupply of gasoline. Further boosts in the Oklahoma refinery price followed during the year, and final December quotations ranged from 4.88 to 5.13 cents a gallon. A price of 5.4 cents a gallon for No. 2 fuel oil at New York harbor, effective late in December 1945, rose to 5.7 cents on January 28, 1946. The quotation ranged higher beginning in July and finally reached an average of 6.43 cents a gallon for the closing month of the year.

Diesel oil at shore plants around New York Harbor, selling at 5.2 cents a gallon, dating from September 1, 1945, was marked upward to 5.7 cents in January 1946, and this value held through July. There were additional advances in August and September for this grade of fuel and still another in early December to a year-end quotation of 6.6 cents a gallon. Ships loading Diesel oil for bunkers in New York Harbor paid $2.15 a barrel beginning September 1, 1945, when all wholesale prices for fuel oils were dropped in line with lower Gulf-East Coast tanker rates. The OPA allowed a mark-up to $2.36 a barrel for ships' Diesel oil in late January 1946, and subsequent advances resulted in a year-end quotation of $2.73 a barrel. Diesel oil for ships fueling at Gulf ports remained at $1.65 a barrel all during 1945; however, there was an advance to $1.86 a barrel in February 1946. The price of Diesel bunkers at Gulf ports followed the upward trend prevailing in other parts of the country in 1946 to a December average of $2.31 a barrel. Quotations for Diesel fuel for ships likewise advanced at San Pedro, Calif., from $1.45 a barrel in January 1946 to an average of $2.39 a barrel for August. This higher price declined to $2.20 in late August and remained at that level for the remainder of the year. Quotations at San Francisco for this same grade of ships' Diesel fuel in 1946 averaged 5 cents higher a barrel.

Representative retail prices for light fuel oils in 1946 followed the upward trend noted in wholesale quotations. Records of retail fuel prices for a number of cities, as published monthly by the Bureau of Labor Statistics, United States Department of Labor, list a quotation of 7.60 cents a gallon for No. 2 distillate fuel oil in New York for December 1945. There was an advance to 7.70 cents a gallon in January 1946 and then to 8.08 cents in February. In the second half of 1946 there were several increases to 8.97 cents a gallon in October and then a slight drop to 8.73 cents for November. This lower value did not hold and the closing quotation of the year was 9.04 cents a gallon. A retail posting for No. 2 distillate in Chicago of

Monthly average prices of distillate fuel oil and Diesel fuel in the United States, 1945–46

[Platt's Oil Price Handbook]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1945													
No. 2 Straw fuel oil at refineries, Oklahoma.....cents per gallon	3.63	3.63	3.63	3.63	3.63	3.63	3.63	3.63	3.63	3.63	3.63	3.63	3.63
No. 2 fuel oil at New York Harbor.....do	6.70	6.70	6.70	6.70	6.70	6.70	6.70	6.70	5.20	5.20	5.20	5.27	6.21
Diesel oil, shore plants, New York Harbor.....do	6.70	6.70	6.70	6.70	6.70	6.70	6.70	6.70	5.20	5.20	5.20	5.20	6.20
Diesel oil for ships:													
New York.....dollars per barrel	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2.78	2.15	2.15	2.15	2.15	2.57
Gulf Coast.....do	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65	1.65
California.....do	1.45	1.45	1.45	14.5	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45
1946													
No. 2 Straw fuel oil at refineries, Oklahoma.....cents per gallon	3.70	4.13	4.13	4.13	4.13	4.13	4.19	4.57	4.56	4.61	4.67	4.98	4.33
No. 2 fuel oil at New York Harbor.....do	5.45	5.70	5.70	5.70	5.70	5.70	5.75	6.33	6.30	6.29	6.13	6.43	5.93
Diesel oil, shore plants, New York Harbor.....do	5.29	5.70	5.70	5.70	5.70	5.70	5.70	6.35	6.50	6.50	6.50	6.60	6.00
Diesel oil for ships:													
New York.....dollars per barrel	2.19	2.36	2.36	2.36	2.36	2.36	2.37	2.61	2.61	2.61	2.65	2.73	2.46
Gulf Coast.....do	1.65	1.76	1.86	1.86	1.86	1.86	1.88	2.09	2.13	2.13	2.21	2.31	1.97
California.....do	1.45	1.51	1.77	1.77	1.77	1.77	1.77	2.39	2.20	2.20	2.20	2.20	1.91

7.45 cents a gallon, dating from December 1945, held until February 1946, when there was an advance to 7.88 cents. The quotations were raised several times during the year until they reached 8.87 cents a gallon in December.

RESIDUAL FUEL OIL

The production of residual fuel oil declined in 1946; however, the smaller supply, supplemented by increased imports and "transfers," was not only adequate to satisfy a lower domestic and export demand, but there was a surplus to add to inventory. Conditions prevailing in 1946 differed somewhat from those in 1945, when part of the residual-fuel-oil supply had to be withdrawn from storage, as a slightly increased production, coupled with lower imports and "transfers," was not adequate to meet an increased demand. The indicated domestic demand for heavy fuel oils in 1946 (477,151,000 barrels) was 9 percent below 1945 requirements of 523,423,000 barrels, while exports continued the downward trend of recent years to 9,486,000 barrels in 1946 compared with foreign shipments of 11,669,000 in 1945—a 19-percent shrinkage.

The drop in demand for residual fuel oils in 1946 was evident throughout the year, as the total for each quarter was well below the corresponding period of 1945. However, the relative shrinkage in quarterly requirements in 1946 diminished as the year advanced or as military and other wartime demands faded with the change-over to peace conditions. The indicated domestic demand for heavy fuel oils in the first quarter of 1946 (126,527,000 barrels) was 13 percent below the comparative 1945 total (144,940,000 barrels) and 12 percent down in the second quarter—116,540,000 barrels in 1946 against 131,688,000 in 1945. However, in the third quarter of 1946, requirements for residual grades (108,168,000 barrels) were only 8 percent under the demand in the same 3 months of 1945 (117,324,000 barrels); by the final period, when the need for heavy heating oils was again a factor and when industrial activities were beginning to approach peacetime conditions, total deliveries of 125,916,000 barrels were within 3 percent of the 1945 comparative item (129,471,000 barrels). A rising market for residual fuel oil in 1947 was evident in the opening quarter, when the indicated demand (137,459,000 barrels) was 9 percent over corresponding 1946 requirements (126,527,000 barrels).

Sales of residual fuel oil [1] in the United States, 1941–45, by uses [2]

[Thousands of barrels]

Use	1941	1942	1943	1944	1945
Railroads	80,565	99,996	116,278	114,535	112,297
Ships' bunkers (including tankers)	56,678	37,817	62,196	92,069	100,365
Gas and electric power plants	33,622	28,101	30,858	34,476	34,532
Smelters, mines, and manufacturing industries	78,024	84,515	84,219	86,664	91,176
Heating oils	46,606	47,483	42,670	40,474	43,874
U. S. Navy, Army, and Coast Guard	25,746	56,531	92,713	101,347	97,485
Oil-company fuel	54,181	44,871	47,123	55,363	57,336
Miscellaneous uses	5,568	6,019	6,420	4,484	5,200
Total United States	380,990	405,333	[3] 482,477	[3] 529,412	[3] 542,265
Exports and shipments to noncontiguous Territories	14,114	12,095	14,894	12,536	11,669
Total	395,104	417,428	497,371	541,948	553,934

[1] Includes Navy grade and crude oil burned as fuel.
[2] Figures for 1946 not yet available.
[3] These totals involve some duplication due to rehandling of fuel oil initially sold to the Government.

Salient statistics of residual fuel oil in the United States, 1945–46, by months and districts

[Thousands of barrels]

Month and district	Production		Yield (percent)		Transfers [1]				Imports		Exports		Domestic demand		Stocks, end of period	
					East of California		California									
	1945	1946 [2]	1945	1946 [2]	1945	1946 [2]	1945	1946 [2]	1945	1946 [2]	1945	1946 [2]	1945	1946 [2]	1945	1946 [2]
By months:																
January	41,862	37,940	28.9	27.1	448	390	1,873	1,036	2,773	3,768	1,143	753	51,849	44,966	44,347	34,573
February	37,141	34,791	27.5	26.7	390	420	1.171	1,014	2,247	3,336	511	794	45,025	39,332	39,760	34,008
March	39,471	37,598	27.0	26.0	432	307	1,362	1,549	3,862	2,735	1,370	973	48,066	42,229	35,451	32,995
April	38,660	37,407	27.0	26.7	395	313	1,369	1,375	3,249	1,883	1,298	856	43,408	37,911	34,418	35,206
May	41,569	37,816	27.3	25.4	408	343	1,514	1,651	2,808	3,794	1,285	532	45,099	39,346	34,333	38,932
June	40,527	36,569	27.1	25.2	382	334	1,506	1,847	3,184	3,659	1,145	566	43,181	39,283	35,606	41,492
July	41,881	36,060	27.0	24.0	366	340	1,538	1,894	2,011	3,325	1,563	931	41,498	36,734	38,341	45,446
August	41,200	35,942	27.0	23.9	398	328	1,689	1,574	1,894	3,487	890	666	40,405	37,925	42,227	48,186
September	34,183	34,512	26.7	23.8	357	275	827	1,655	1,270	3,932	621	1,039	35,421	33,509	42,822	54,012
October	36,452	33,777	27.7	23.0	411	324	1,310	1,969	2,490	3,323	599	811	40,818	37,014	42,068	55,580
November	37,937	33,015	27.4	23.5	312	325	902	2,022	3,473	3,804	497	514	42,873	41,497	41,322	52,735
December	38,609	35,937	27.2	24.3	389	366	978	1,491	2,387	5,021	747	1,051	45,780	47,405	37,158	47,094
Total	469,492	431,364	27.3	24.9	4,688	4,065	16,039	19,077	31,648	42,067	11,669	9,486	523,423	477,151	37,158	47,094
By districts:																
East Coast	85,352	80,007	31.2	28.9											7,057	8,399
Appalachian	9,152	8,616	16.3	15.5											467	528
Indiana, Illinois, Kentucky, etc	53,494	54,323	19.4	19.4	585	532									2,587	4,200
Oklahoma, Kansas, and Missouri	24,764	23,406	17.8	16.9	269	243									1,024	1,280
Texas Inland	22,491	20,092	26.0	25.5	837	897			(3)	(3)	(3)	(3)	(3)	(3)	687	736
Texas Gulf Coast	88,617	90,200	22.0	21.2	751	469									5,051	6,935
Louisiana Gulf Coast	17,062	17,040	17.2	14.1	991	942									1,458	1,864
Arkansas and Louisiana Inland	6,331	5,068	22.7	23.1	672	551									270	143
Rocky Mountain	13,253	13,388	28.8	27.9	583	431									725	604
California	148,976	119,224	47.5	41.8			16,039	19,077							17,832	22,405
Total	469,492	431,364	27.3	24.9	4,688	4,065	16,039	19,077	31,648	42,067	11,669	9,486	523,423	477,151	37,158	47,094

[1] Represents quantities used on leases and for general industrial purposes.
[2] Subject to revision.
[3] Figures not available.

Sales of heavy fuel oil by principal uses in 1946, as reported in the annual survey conducted by the Bureau of Mines, have not been released; however, estimates of the several requirements, based on available monthly figures and other information, have been made and are as follows: Railroads, 101,500,000 barrels; bunkering of vessels, 81,000,000 barrels, of which amount 55,340,000 barrels were loaded at continental ports of the United States on ships engaged in foreign trade, according to the Bureau of the Census, United States Department of Commerce; gas and electric power plants, 51,350,000 barrels; smelters, mines, and manufacturing plants, 95,000,000 barrels; heating oils, 49,000,000 barrels; oil-company fuel, 58,500,000 barrels; and military requirements and miscellaneous uses, 40,800,000 barrels.

The columns in figure 11 represent the fluctuating annual demand for residual fuel oils by principal uses in 1937–45. All heavy fuel oils, including Navy grade and crude petroleum used as fuel, are included.

A gradual decline in exports of residual fuel oil, evident in 1944, continued into 1946, when foreign shipments (9,846,000 barrels) were 19 percent below the 1945 total (11,669,000 barrels). There were no shipments of residual fuel oil to the United Kingdom in 1946 compared with 4,360,000 barrels in 1945, according to the Bureau of the Census, United States Department of Commerce; however, this loss in the overseas trade was partly offset by gains shown for other countries. Canada received 1,924,000 barrels of heavy fuel oil in 1946 compared with 734,000 in 1945, while shipments to Mexico rose from 583,000 barrels in 1945 to 836,000 in 1946. There was a slight increase in the requirements of Cuba from 1,005,000 barrels in 1945 to 1,137,000 in 1946, and exports of residual fuel oil to U. S. S. R. jumped noticeably from 159,000 barrels in 1945 to 874,000 in 1946. Various countries received the following quantities of American heavy fuel oil in 1946: Sweden, 134,000 barrels; Denmark, 187,000 barrels; Belgium, 168,000 barrels; and China, 211,000 barrels against no recorded receipts for those same countries in 1945.

The volume of crude runs through refineries in 1946 varied only slightly compared with 1945; however, the yield for residual fuel oils was cut from 27.3 percent in 1945 to 24.9 percent in 1946, to make more of the distillate grades. As a result the production of residuals dropped by 8 percent from 469,492,000 barrels in 1945 to 431,364,000 in 1946. The lower output of heavy fuel oil in 1946 is in contrast to a 2-percent gain in 1945 and an 11-percent gain in 1944. Residual fuel oil produced in 1946 made up 87 percent of the total available supply from all sources and compares with an 88-percent share in 1945.

Only three refinery districts—Indiana-Illinois-Kentucky, Texas Gulf, and the Rocky Mountain—reported small gains in the production of residual fuel oil in 1946. About 19 percent of the heavy fuel oil made in the country is credited to the East Coast States, and the quantity dropped 6 percent from 85,352,000 barrels in 1945 to 80,007,000 in 1946. The crude petroleum processed in the area was up slightly in 1946 compared with 1945; however, the yield for residual fuel oils was only 28.9 percent in 1946 against 31.2 percent in 1945 and hence the lower production. It should be added that runs of

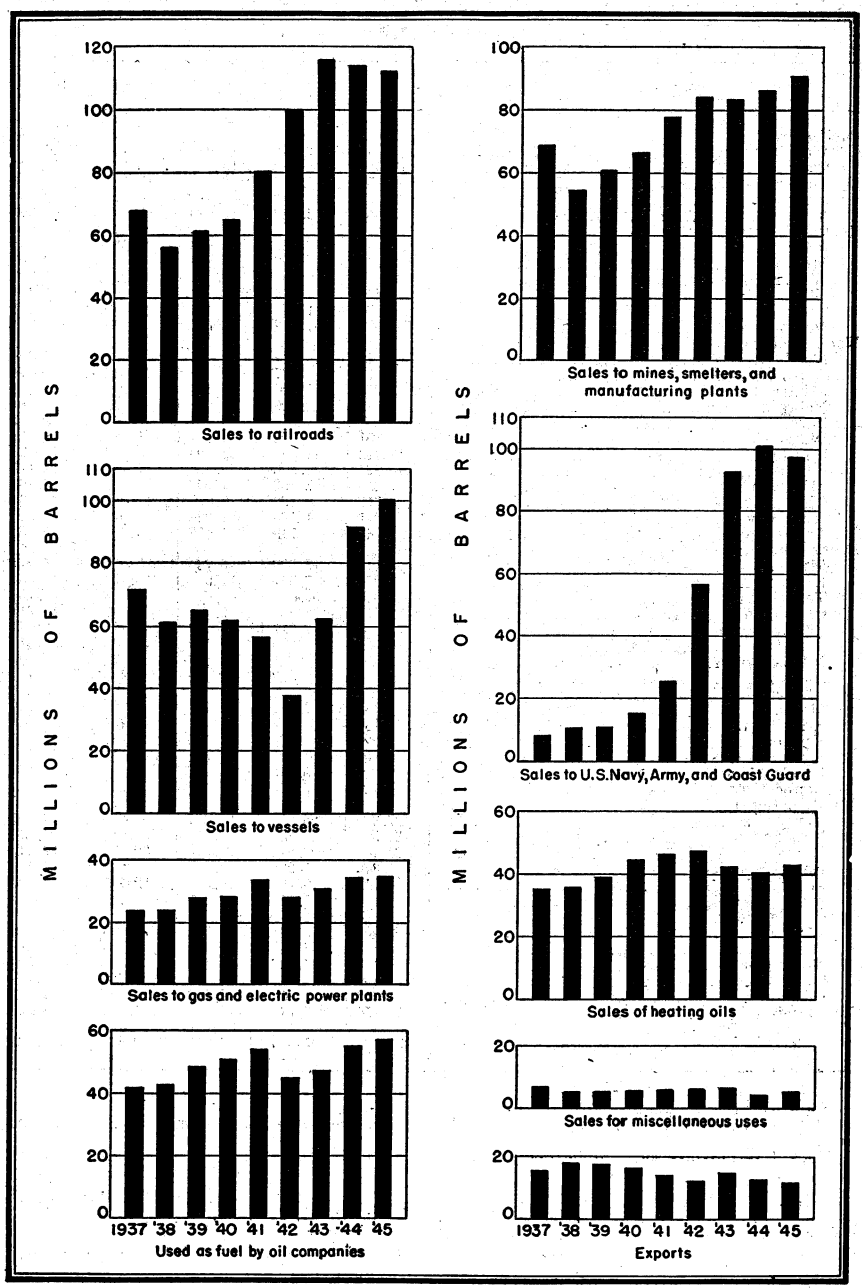

FIGURE 11.—Sales of residual fuel oil in the United States, 1937–45, by uses.

Sales of residual fuel oil [1] in the United States, 1941–45, by regions and States [2]

[Thousands of barrels]

Region [3] and State	1941	1942	1943	1944	1945
Pacific Coast:					
Washington	8,482	11,431	12,991	12,896	13,615
Oregon	10,519	13,036	15,958	15,638	17,205
California	66,172	87,019	118,848	116,127	129,514
Arizona	3,775	3,947	4,117	2,905	2,706
Nevada	3,810	5,422	6,940	7,507	6,626
Rocky Mountain:					
Idaho	457	561	603	580	557
Montana	2,743	3,392	3,804	5,460	6,253
Wyoming	2,004	2,296	2,572	5,327	4,710
Utah	476	571	887	1,202	1,396
Colorado	926	1,148	1,404	1,489	1,262
New Mexico	503	552	595	755	1,184
North Central:					
North Dakota	40	42	93	104	623
South Dakota	214	167	212	226	241
Minnesota	1,275	1,194	1,170	1,219	1,106
Nebraska	649	626	648	556	581
Iowa	801	685	986	913	882
Wisconsin	1,801	1,612	1,667	1,806	1,671
Illinois	12,413	13,083	14,694	15,540	15,092
Indiana	10,025	9,220	9,220	11,776	12,118
Michigan	7,215	7,532	7,257	6,506	6,482
Ohio	8,312	9,126	10,624	10,897	11,534
Kentucky	911	1,123	1,222	1,022	926
Tennessee	645	749	1,082	1,580	1,550
South Central:					
Missouri	5,517	5,720	6,730	6,030	5,971
Kansas	8,256	7,747	11,099	10,754	10,584
Texas	48,330	57,027	75,625	79,495	81,758
Oklahoma	8,913	8,856	9,711	8,787	8,314
Arkansas	2,326	2,627	3,229	3,110	2,321
Louisiana	14,997	11,309	12,788	14,003	13,416
Mississippi	461	271	465	618	505
Alabama	1,980	2,322	2,466	2,468	3,131
New England:					
Maine	2,482	2,141	1,754	2,061	1,718
New Hampshire	1,134	814	433	701	536
Vermont	224	206	110	107	142
Massachusetts	16,909	14,727	12,548	16,595	14,513
Rhode Island	6,900	5,176	3,168	4,008	4,168
Connecticut	5,729	5,076	4,114	4,347	4,934
Middle Atlantic:					
New York	27,326	25,248	27,207	25,635	27,105
New Jersey	31,972	30,337	36,111	56,143	49,272
Pennsylvania	23,100	22,817	24,515	32,529	35,210
Delaware	1,346	1,298	1,334	879	1,173
Maryland	10,215	9,693	10,854	12,287	12,889
District of Columbia	1,380	1,114	952	759	866
South Atlantic:					
Virginia	2,605	2,231	4,584	6,643	5,943
West Virginia	986	983	1,244	980	888
North Carolina	419	522	500	384	504
South Carolina	899	989	670	1,029	790
Georgia	1,942	1,808	2,502	2,807	2,821
Florida	10,474	9,740	10,770	14,222	14,959
Total	380,990	405,333	[4] 482,477	[4] 529,412	[4] 542,265

[1] Includes some crude oil burned as fuel.
[2] Figures for 1946 not yet available.
[3] States are grouped according to petroleum-marketing territories rather than to conventional geographic regions.
[4] These totals involve some duplication due to rehandling of fuel oil initially sold to the Government.

foreign crude (usually of high residual fuel-oil content) in the East Coast district gained in volume in 1946 as it did in 1945, yet this favorable factor made no measurable difference in the lower yield reported.

The Texas Gulf Coast region is an important source of residual fuel oils, and the production (about a fifth of the national total) increased from 88,617,000 barrels in 1945 to 90,200,000 in 1946.

Increased runs (5 percent over 1945) in this district were sufficient to counteract a lower yield—21.2 percent in 1946 compared with 22.0 percent in 1945—hence the gain in the output of heavy fuel oils. California produces more residual fuel oil than any other area; however, the quantity declined by 20 percent—from 148,976,000 barrels in 1945 to 119,224,000 in 1946—due both to a 9-percent drop in crude runs and a greatly reduced yield—41.8 percent in 1946 compared with 47.5 percent in 1945.

The Indiana-Illinois-Kentucky refinery district is also the source of an important quantity of heavy fuel oil; and the total rose from 53,494,000 barrels in 1945 to 54,323,000 in 1946, mainly because of a small increase in crude runs, as the yield remained fixed at 19.4 percent for both years. A lower yield and smaller crude runs in the Oklahoma-Kansas-Missouri group of States resulted in a drop in the production of residuals from 24,764,000 barrels in 1945 to 23,406,000 in 1946. Similar operating conditions also prevailed in the Texas Inland district, and the heavy fuel oil realized fell off from 22,491,000 barrels in 1945 to 20,092,000 in 1946. Crude petroleum processed in the Louisiana Gulf area gained substantially (22 percent over 1945); however, as the yield for residual grades of fuel oil was lowered from 17.2 percent in 1945 to 14.1 percent in 1946, the output of 17,040,000 barrels in 1946 differed very little from the 1945 total of 17,062,000 barrels. The remaining refinery districts—Appalachian, Arkansas and Louisiana Inland, and the Rocky Mountain—do not produce large quantities of heavy fuel oils, and the Rocky Mountain area was the only one of this group to show a gain in 1946.

Considerable quantities of heavy crude petroleum are used directly as fuel on leases and for general industrial purposes. Such crude oils are credited to the fuel-oil account as "transfers" and totaled 23,142,000 barrels in 1946, a gain of 12 percent over the 1945 item of 20,727,000 barrels. This crude used as fuel represented about 5 percent of the total supply of heavy fuel oils in 1946 and approximately 4 percent in 1945. The larger share of the "transfers" are reported from the California refinery district—19,077,000 barrels in 1946 compared with 16,039,000 in 1945—while quantities in the other refinery areas declined from 4,688,000 barrels in 1945 to 4,065,000 in 1946. No "transfers" of this kind are made in the East Coast and Appalachian districts.

Imports of residual into continental United States, which dropped 13 percent in 1945, expanded to 42,067,000 barrels in 1946, a 33-percent gain over the 1945 total of 31,648,000 barrels. Heavy fuel oil received from foreign sources made up about 9 percent of the total supply in 1946 compared with a 6-percent share in 1945. Practically all of the residual fuel oil received from abroad in 1945 and 1946 came from Curaçao, Netherlands West Indies, while relatively smaller amounts were credited to a number of other countries, including Canada, Mexico, Venezuela, Trinidad, Colombia, and Rumania.

A lower domestic demand, together with increased imports and curtailed exports, were factors that resulted in an improved residual fuel-oil stock situation in 1946 compared with 1945, even though the production and percentage yield were unfavorable. The volume of year-end stocks of heavy fuel oils expanded from 37,158,000 barrels

793065—48——62

in 1945 to 47,094,000 in 1946—a 27-percent gain in contrast to a 26-percent loss in similar inventories in 1945. Stocks of residual fuel oil held at refineries, as well as those at bulk terminals, showed increases in 1946 instead of pronounced declines, as in 1945. Quantities reported at refineries rose from 28,749,000 barrels at the close of 1945 to 37,414,000 in 1946—a 30-percent gain—while those held at bulk terminals were up 15 percent from 8,409,000 barrels in 1945 to 9,680,000 in December 1946.

During 1945, 13,225,000 barrels of heavy fuel oil were withdrawn from storage to meet the demand, while in 1946 the supply situation was more favorable as there was an addition to inventory of 9,936,000 barrels. Expressed on a percentage basis, about 3 percent of the needed quantity of heavy fuel oils came from stocks in 1945; however, in 1946 there was a 2-percent excess, which was diverted to storage. Residual grades of fuel oil held at refineries and bulk terminals at the year end of 1946 were sufficient for 30 days of supply at the subsequent January rate of indicated total demand, and this volume compares with a 25-day supply at the close of 1945 and 29 days for 1944.

Nearly half of the residual fuel-oil stocks are carried in the California refinery district, and the quantity reported increased by 26 percent from 17,832,000 barrels in 1945 to 22,405,000 in December 1946. Important inventories of heavy fuel oil are also held in the East Coast and Texas Gulf Coast areas. Those in the East Coast account for about a fifth of the national total, and the quantity expanded by 19 percent from 7,057,000 barrels in 1945 to 8,399,000 for 1946, while in the Texas Gulf Coast, a supply area, the year-end totals were 5,051,000 barrels for 1945 and 6,935,000 in 1946. Heavy fuel-oil inventories in the Indiana-Illinois-Kentucky group of States rose from 2,587,000 barrels or 7 percent of the national total in 1945 to 4,200,000 or 9 percent of all stocks in 1946. The heavy fuel oil stored in the remaining refinery districts is not relatively important and represented only about 12 percent of the total supply in 1945 and 11 percent in 1946. Four of these areas—the Appalachian, Oklahoma-Kansas-Missouri, Texas Inland, and the Louisiana Gulf Coast—reported gains in residual stocks in 1946, while quantities in the Arkansas-Louisiana Inland and Rocky Mountain districts were lower at the end of 1946 compared with 1945.

No residual fuel oil was moved by tanker from the California refinery district to eastern areas in 1945 or 1946. However some little heavy fuel oil—91,000 barrels in 1946 compared with 158,000 in 1945 and 182,000 in 1944—was shipped out by rail and truck to other Western States. There were also some receipts of residual grades from other refinery areas—734,000 barrels in 1946 compared with 773,000 in 1945 and 571,000 in 1944.

The tanker and barge movement of residual fuel oil from the Gulf to East Coast ports is still well below the record volume of 75,923,000 barrels made in 1941; however, there was a substantial increase in this traffic in 1946 to 55,186,000 barrels—a gain of 48 percent over the 1945 total of 37,192,000 barrels. Texas is the source of most of this heavy fuel oil moved by tanker to the Atlantic coast—49,071,000

barrels in 1946 and 34,409,000 in 1945—while Louisiana supplies the balance—6,115,000 barrels in 1946 and 2,783,000 in 1945.

Petroleum refiners operating along the Gulf coast send some heavy fuel oil up the Mississippi River by barge; however, this movement has fallen under peacetime conditions from 1,182,000 barrels in 1944 to 1,042,000 in 1945 and down to 642,000 in 1946. Louisiana is credited with most of this oil, while a small portion comes from Texas.

There were no changes in tanker rates in 1946 for heavy fuel oil moved between the Gulf and East Coast ports, not east of New York. A charge of 43.8 cents a barrel for 10°–19.9° gravity fuel oil, effective October 15, 1945, was maintained all during 1946. The actual freight is based on a rate of $2.85 a long ton for all petroleum products, and the equivalent cost per barrel varies with the gravity of the oil shipped.

The price of representative grades of residual fuel oil moved upward in 1946. A quotation for No. 6 at refineries in Oklahoma (94 cents a barrel) held all during 1945 and until March 1946, when the monthly average rose to $1.03. An average value of $1.15 a barrel was maintained during the second quarter of the year and after several changes reached $1.28 a barrel in August 1946. The price was shaded several cents a barrel during the September-November period and then jumped to an average of $1.36 a barrel as the demand increased at the year end.

Market quotations on No. 5 fuel oil at New York Harbor averaged $1.90 a barrel from early October 1944 through August 1945 and then dropped to $1.68 in September with inauguration of postwar tanker rates. There was a 4-cent reduction per barrel in late November 1945, and the December average was $1.64 per barrel or $1.82 average for the year. There were no further changes until March 1946, when the quoted price was raised to $1.90 a barrel. Late July brought another increase, and by September 1946 the average cost of No. 5 fuel oil was $2.25 a barrel. This value was reduced slightly in the fall months; however, the December average reached $2.32 a barrel and the weighted price for all of 1946 was $1.99 a barrel.

Bunker "C" fuel oil at New York Harbor dropped from $1.77 to $1.55 a barrel on September 1, 1945, and then to $1.51 on November 28, when normal tanker rates were put into effect. Quotations for Bunker "C" followed the upward trend of other fuel-oil prices in 1946 and finally reached an average of $1.97 a barrel in August. This higher value did not hold and finally settled to $1.92 a barrel during the closing 4 months of 1946. A price of 97 cents a barrel for Bunker "C" at Gulf ports, effective in August 1944, was maintained all during 1945 and until March 1946, when it advanced to $1.06 a barrel. The quotation for this grade of ships' bunkers was raised during the summer months until it reached an average of $1.49 a barrel in August 1946. There was a temporary reduction until December, when it rose to an average of $1.54 a barrel. Bunker "C" for ships loading at San Pedro, Calif., was quoted at $1.10 a barrel all during 1945 and until March 25, 1946, when the price was raised to $1.25 and remained there for the balance of the year.

Monthly average prices of residual fuel oil in the United States, 1945–46

[Platt's Oil Price Handbook]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1945													
No. 6 fuel oil at refineries, Oklahoma ---- dollars per barrel	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
No. 5 fuel oil at New York Harbor ---- do	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.68	1.68	1.67	1.64	1.82
Bunker "C" for ships:													
New York ---- do	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.77	1.55	1.55	1.54	1.51	1.69
Gulf Coast ---- do	.97	.97	.97	.97	.97	.79	.97	.97	.97	.97	.97	.97	.97
California ---- do	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
1946													
No. 6 fuel oil at refineries, Oklahoma ---- dollars per barrel	.94	.94	1.03	1.15	1.15	1.15	1.16	1.28	1.24	1.24	1.25	1.36	1.16
No. 5 fuel oil at New York Harbor ---- do	1.64	1.64	1.75	1.90	1.90	1.90	1.91	2.23	2.25	2.22	2.23	2.32	1.99
Bunker "C" for ships:													
New York ---- do	1.51	1.51	1.60	1.72	1.72	1.72	1.74	1.97	1.92	1.92	1.92	1.92	1.76
Gulf Coast ---- do	.97	.97	1.06	1.18	1.18	1.18	1.22	1.49	1.48	1.43	1.47	1.54	1.26
California ---- do	1.10	1.10	1.14	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.22

LUBRICATING OIL

The refinery production of lubricating oil amounted to 45,645,000 barrels in 1946 for a new all-time high. This represents an increase of 3,778,000 barrels or 9 percent over the production in 1945. The principal gains were in the East Coast and Texas Gulf Coast districts, where the percentage increases were 12 and 22, respectively. The production in these two districts was about 50 percent of the total. Production in the Appalachian district was 5,175,000 barrels in 1946 compared with 4,891,000 barrels in 1945.

The percentage yield of lubricating oil from crude rose from 2.4 in 1945 to 2.7 in 1946. This is just below the average yield for the prewar period from 1939 through 1941.

The total demand for lubricating oil increased from 41,909,000 barrels in 1945 to a new "record" of 45, 942, 000 barrels in 1946. This increase of 4,033,000 barrels comprised an increase of 4,483,000 barrels in exports and a decrease of 450,000 barrels in domestic demand. Domestic demand for lubricating oil in 1946 was 41 percent above domestic demand in 1940, compared with a 35-percent increase in the domestic demand for all oils in the same period. Exports in 1945 dropped to the lowest level in over 25 years, but the 68-percent increase in 1946 produced a total that was exceeded only by the exports in 1939.

Salient statistics of lubricating oil in the United States, 1945–46, by months and districts

Month and district	Production (thousands of barrels)		Yield (percent)		Domestic demand (thousands of barrels)		Stocks, end of period (thousands of barrels)	
	1945	1946 [1]	1945	1946 [1]	1945	1946 [1]	1945	1946 [1]
By months:								
January	3,504	3,395	2.4	2.4	3,085	2,689	7,796	7,694
February	3,062	3,159	2.3	2.4	2,792	2,275	7,641	7,966
March	3,589	3,786	2.5	2.6	3,253	2,562	7,423	7,951
April	3,716	3,693	2.6	2.6	3,270	3,061	7,307	7,852
May	3,882	3,722	2.6	2.5	3,374	2,866	7,026	7,565
June	3,567	3,839	2.4	2.6	3,130	2,715	6,770	7,635
July	3,645	3,620	2.3	2.4	3,266	3,049	6,321	7,293
August	3,712	4,096	2.4	2.7	3,121	3,236	6,505	7,030
September	3,128	4,016	2.4	2.8	2,328	3,095	6,840	7,244
October	3,265	4,327	2.5	3.0	2,577	3,536	7,221	7,338
November	3,485	3,857	2.5	2.7	2,532	2,900	7,595	7,384
December	3,312	4,135	2.3	2.8	2,606	2,900	7,773	7,564
Total	41,867	45,645	2.4	2.7	35,334	34,884	7,773	7,564
By districts:								
East Coast	8,358	9,332	3.1	3.4			2,327	2,172
Appalachian	4,891	5,175	8.7	9.3			506	597
Indiana, Illinois, Kentucky, etc.	4,446	4,800	1.6	1.7			794	809
Oklahoma, Kansas, and Missouri	5,361	5,479	3.9	4.0			629	460
Texas Inland	248	282	.3	.4			34	36
Texas Gulf Coast	10,989	13,399	2.7	3.2	[2]	[2]	1,791	1,672
Louisiana Gulf Coast	2,036	2,098	2.1	1.7			204	216
Arkansas and Louisiana Inland	1,453	1,380	5.2	6.3			157	113
Rocky Mountain	265	278	.6	.6			77	77
California	3,820	3,422	1.2	1.2			1,254	1,412
Total	41,867	45,645	2.4	2.7	35,334	34,884	7,773	7,564

[1] Subject to revision.
[2] Figures not available.

Average monthly refinery prices of five selected grades of lubricating oil in the United States, 1945–46, in cents per gallon

[National Petroleum News]

Grade	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1945													
Oklahoma:													
200 viscosity, No. 3 color, neutral	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50	13.50
150–160 viscosity at 210°, bright stock, 10–25 pour test	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75
Pennsylvania:													
200 viscosity, No. 3 color, neutral, 420–425 flash, 25 pour test	30.50	30.50	30.50	30.50	30.50	30.50	30.50	30.50	30.50	30.50	30.50	30.50	30.50
600 steam-refined, cylinder stock, filterable	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Gulf Coast: 500 viscosity, No. 2½–3½ color, neutral	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
1946													
Oklahoma:													
200 viscosity, No. 3 color, neutral	13.50	13.50	13.50	13.50	13.64	14.08	14.57	15.50	15.50	16.00	16.08	16.79	14.68
150–160 viscosity at 210°, bright stock, 10–25 pour test	22.75	22.75	22.75	22.75	22.75	22.75	22.84	24.34	25.35	26.16	26.33	28.75	24.19
Pennsylvania:													
200 viscosity, No. 3 color, neutral 420–425 flash, 25 pour test	30.50	30.50	30.50	30.50	30.50	30.50	30.84	32.75	34.13	36.28	36.50	37.07	32.55
600 steam-refined, cylinder stock, filterable	15.00	15.00	15.00	15.00	15.00	15.00	15.36	19.00	21.36	24.30	25.00	26.38	18.45
Gulf Coast: 500 viscosity, No. 2½–3½ color, neutral	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.85	11.38	11.38	11.68	12.13	10.62

OTHER PRODUCTS

Wax.—Refinery production of petroleum wax has increased each year since 1938. The production of 841 million pounds in 1946 represented an increase of 3 percent over 1945 and 64 percent over 1940. About 37 percent of the 1946 total was produced in the East Coast district, 15 percent in the Texas Gulf Coast district, and 13 percent in the Oklahoma-Kansas district. In the prewar years, imports of wax, chiefly from the East Indies, represented as much as 14 percent of the total new supply in the United States, but the major foreign source of supply vanished with the Japanese invasion of the East Indies producing area.

Domestic demand for petroleum wax declined from the all-time peak of 673 million pounds in 1945 to 636 million in 1946. However, this 1946 demand was 78 percent above the domestic demand in 1940. Exports in 1946 increased to 201 million pounds, but were still 3 percent below the average of exports in the 3-year period from 1938–40.

Salient statistics of wax in the United States, 1945–46, by months and districts

[Thousands of pounds]

Month and district	Production		Domestic demand		Exports		Stocks, end of period	
	1945	1946 [1]	1945	1946 [1]	1945	1946 [1]	1945	1946 [1]
By months:								
January	71,960	65,520	57,728	46,480	19,552	20,440	88,480	80,640
February	64,960	64,960	51,919	50,569	15,281	13,551	86,240	81,480
March	81,480	77,280	65,274	58,438	15,086	14,922	87,360	85,400
April	70,560	68,040	62,995	56,415	10,385	16,105	84,840	80,920
May	71,120	67,760	65,714	55,229	9,046	16,171	81,200	77,280
June	70,280	65,520	71,289	41,738	8,791	19,302	71,400	81,760
July	71,400	60,480	56,897	52,810	7,586	15,641	78,680	73,920
August	73,360	69,160	59,936	52,987	10,006	16,733	82,600	73,360
September	54,040	68,600	38,594	43,764	14,079	15,036	84,280	83,160
October	58,240	74,480	45,590	65,517	12,970	7,283	84,280	84,840
November	66,640	79,240	51,163	52,024	16,597	22,176	83,160	89,880
December	63,840	79,800	45,813	59,964	19,147	23,476	82,040	86,240
Total	817,880	840,840	672,912	635,935	158,526	200,836	82,040	86,240
By districts:								
East Coast	309,400	310,240	[2]	[2]	[2]	[2]	28,840	35,000
Appalachian	102,480	99,960					18,480	19,600
Indiana, Illinois, Kentucky, etc.	60,200	53,760					9,800	10,920
Oklahoma, Kansas, and Missouri	90,160	106,960					5,880	6,160
Texas Inland	2,240	2,520					9,240	7,840
Texas Gulf Coast	122,080	130,200					1,400	1,400
Louisiana Gulf Coast	82,320	89,600					7,000	4,480
Rocky Mountain	25,200	21,840					1,400	840
California	23,800	25,760						
Total	817,880	840,840	672,912	635,935	158,526	200,836	82,040	86,240

[1] Subject to revision.
[2] Figures not available.

Average monthly refinery price of 124°–126° white crude scale wax at Pennsylvania refineries, 1942–46, in cents per pound

[National Petroleum News]

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for year
1942	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25
1943	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25
1944	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25
1945	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25
1946	4.25	4.25	4.25	4.25	4.25	4.25	4.32	5.66	5.76	6.00	6.00	6.07	4.94

Coke.—The production of petroleum coke amounted to 2,124,200 short tons in 1946 compared with 2,023,000 tons in 1945. Exports increased from 209,200 tons in 1945 to 386,200 tons in 1946, but domestic demand declined 2 percent to 1,806,200 tons in 1946.

The principal refinery districts producing coke, in order of their importance in 1946, were the Indiana-Illinois, Texas Gulf Coast, Louisiana Gulf Coast, California, Oklahoma-Kansas, Texas Inland, and East Coast districts. The Illinois-Indiana district produced 49 percent of the total in 1946 compared with 56 percent in 1945.

Salient statistics of petroleum coke in the United States, 1945–46, by months and districts

Month and district	Production (thousands of short tons)		Yield (percent)		Domestic demand (thousands of short tons)		Stocks, end of period (thousands of short tons)	
	1945	1946 [1]	1945	1946 [1]	1945	1946 [1]	1945	1946 [1]
By months:								
January	181.4	160.6	0.6	0.6	187.0	153.2	174.4	146.4
February	163.0	149.0	.6	.6	194.6	122.2	131.2	146.8
March	172.4	166.6	.6	.6	161.9	142.6	124.8	141.8
April	184.2	181.2	.6	.7	149.7	156.8	140.8	144.4
May	178.6	164.4	.6	.6	147.8	150.4	150.4	120.0
June	171.6	159.0	.6	.5	157.2	115.5	147.6	85.0
July	184.8	168.0	.6	.6	165.6	149.0	154.0	78.0
August	180.4	185.8	.6	.6	154.0	160.6	160.4	71.6
September	148.2	189.8	.6	.6	131.8	156.9	162.2	89.0
October	143.6	212.2	.5	.7	124.8	184.0	159.0	95.6
November	152.0	190.6	.5	.7	124.2	153.2	159.4	93.4
December	162.8	197.0	.6	.7	144.2	161.8	158.2	90.0
Total	2,023.0	2,124.2	.6	.6	1,842.8	1,806.2	158.2	90.0
By districts:								
East Coast	73.6	119.6	.1	.2			1.0	.2
Appalachian	30.2	29.2	.3	.2			3.0	.6
Indiana, Illinois, Kentucky, etc.	1,138.8	1,034.2	2.1	1.8			45.4	27.0
Oklahoma, Kansas, and Missouri	148.6	138.8	.5	.5	(2)	(2)	4.4	3.8
Texas Inland	126.2	131.8	.7	.8			3.8	.8
Texas Gulf Coast	200.8	227.8	.2	.3			11.8	2.4
Louisiana Gulf Coast	141.0	209.0	.7	.9			.8	1.2
Rocky Mountain	38.8	44.2	.4	.5			11.6	8.0
California	125.0	189.6	.2	.3			76.4	46.0
Total	2,023.0	2,124.2	.6	.6	1,842.8	1,806.2	158.2	90.0

[1] Subject to revision.
[2] Figures not available.

Asphalt and Road Oil.—The domestic demand for asphalt increased from 6,972,800 short tons in 1945 to 7,909,700 tons in 1946—a gain of 13 percent. Imports declined from 147,100 tons in 1945 to 125,700 tons in 1946, while exports increased 59 percent to 372,300 tons in 1946. The wartime restrictions on the production and use of road oil resulted in a very low indicated demand for this product in 1944—1,560,000 barrels. This demand increased to 2,505,000 barrels in 1945 and to 5,939,000 barrels in 1946. However, the 1946 demand was still 34 percent below the demand in 1941.

Detailed statistics for asphalt and road oil appear in the Asphalt and Related Bitumens chapter of this volume.

Still Gas.—The production of still gas dropped from 372 billion cubic feet in 1945 to 317 billion cubic feet in 1946, with a decline in every refinery district. The Texas Gulf Coast district, with an output of 83 billion cubic feet, continued as the major producer in 1946. Other important producing districts were: Indiana-Illinois, East Coast, and California.

Production of still gas in the United States, 1944–46, by districts

District	1944		1945		1946 [1]	
	Millions of cubic feet	Equivalent, in thousands of barrels	Millions of cubic feet	Equivalent, in thousands of barrels	Millions of cubic feet	Equivalent, in thousands of barrels
East Coast	50,501	14,028	49,547	13,763	45,688	12,691
Appalachian	12,319	3,422	12,632	3,509	12,370	3,436
Indiana, Illinois, Kentucky, etc	66,294	18,415	62,759	17,433	60,837	16,899
Oklahoma, Kansas, and Missouri	25,337	7,038	26,489	7,358	24,235	6,732
Texas Inland	15,239	4,233	16,128	4,480	15,725	4,368
Texas Gulf Coast	114,966	31,935	108,227	30,063	83,142	23,095
Louisiana Gulf Coast	29,462	8,184	34,225	9,507	22,363	6,212
Arkansas and Louisiana Inland	4,648	1,291	6,059	1,683	4,759	1,322
Rocky Mountain	6,858	1,905	8,114	2,254	7,693	2,137
California	42,437	11,788	48,269	13,408	40,478	11,244
Total	368,061	102,239	372,449	103,458	317,290	88,136

[1] Subject to revision.

Miscellaneous Oils.—The domestic demand for finished miscellaneous products increased from 37,857,000 barrels in 1945 to 46,026,000 barrels in 1946—a gain of 22 percent. The major products in this group are liquefied gases for fuel use and for chemical and rubber manufacture. In 1946, the domestic demand for liquefied gases amounted to 39,736,000 barrels, and the domestic demand for all other products in the miscellaneous group was 6,290,000 barrels. The supply of liquefied gases is derived from natural-gasoline and cycle plants and from refinery production. Transfers from natural-gasoline and cycle plants in 1946 amounted to 25,458,000 barrels, and refinery production of liquefied gases totaled 15,440,000 barrels. Refinery production of all other products in the miscellaneous group amounted to 7,099,000 barrels, but no detailed break-down of the output by products is available.

INTERCOASTAL SHIPMENTS [2]

Shipments of mineral oils, crude and refined, from Gulf coast ports to east coast ports more than doubled from 1945 to 1946. Crude petroleum was the largest single item in these 1946 shipments; it constituted 40 percent of the total shipments in 1946 compared with 36 percent in 1945. Gasoline occupied second place in importance; its shipments constituted 26 percent of the whole in 1946 compared with 24 percent in 1945. Intercoastal shipments of all varieties of mineral oils were considerably larger in 1946 than in 1945. The lowest rate of increase of all specified varieties—that of residual fuel oil—was 48 percent.

[2] By A. H. Redfield, Petroleum Economics Branch, Bureau of Mines.

Mineral oils, crude and refined, shipped commercially from Gulf coast to east coast ports of the United States, 1945–46, by classes [1]

[Thousands of barrels]

Class	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1945													
Crude petroleum	3,498	3,016	3,392	2,968	3,023	2,685	4,240	3,944	6,469	9,854	15,888	14,525	73,502
Gasoline	2,316	1,931	2,327	1,941	2,277	2,023	1,746	3,340	5,346	7,054	9,813	8,679	48,793
Kerosine	780	646	605	505	320	936	716	734	1,174	1,383	2,101	3,328	13,228
Distillate fuel oil	2,695	3,926	1,918	711	404	588	1,197	1,281	2,055	2,563	4,437	6,400	28,175
Residual fuel oil	3,055	3,323	3,717	2,058	1,405	2,155	2,657	2,646	2,197	3,392	4,929	5,658	37,192
Lubricating oils	------	------	------	------	------	------	65	171	8	214	256	310	1,024
Miscellaneous oils	------	8	499	196	309	133	47	6	52	238	340	349	2,177
	12,344	12,850	12,458	8,379	7,738	8,520	10,668	12,122	17,301	24,698	37,764	39,249	204,091
1946													
Crude petroleum	16,870	17,822	16,015	14,862	15,924	17,772	16,107	16,002	15,145	14,569	14,864	15,730	[2]191,682
Gasoline	10,734	8,809	9,232	10,751	10,505	10,742	11,718	11,703	9,547	10,016	9,940	10,270	123,967
Kerosine	4,096	3,206	3,340	2,799	1,945	2,134	2,863	2,452	2,062	2,703	2,724	4,011	34,335
Distillate fuel oil	6,901	7,323	6,398	4,663	4,663	4,417	5,284	4,812	5,305	5,004	5,095	8,986	68,851
Residual fuel oil	4,714	5,048	4,203	5,035	4,672	4,681	3,970	4,303	3,803	4,035	4,834	5,888	55,186
Lubricating oils	460	477	598	449	575	463	574	656	569	513	762	504	6,600
Miscellaneous oils	235	166	364	135	257	266	199	387	234	152	274	121	2,790
	44,010	42,851	40,150	38,694	38,541	40,475	40,715	40,315	36,665	36,992	38,493	45,510	483,411

[1] Oil and Gas Division, U. S. Department of the Interior.
[2] Includes 1,711,000 barrels for export.

FOREIGN TRADE [3]

Imports of mineral oils, crude and refined, into continental United States increased 19 percent from 1945 to 1946. They constituted 6 percent of the total new supply in continental United States in 1945 and 7 percent in 1946.

Crude petroleum, residual fuel oil, and distillate fuel oil together made up 97 percent of the total mineral-oil imports into continental United States in 1945 and 99 percent in 1946. Virtually all these imports came from ports of the Caribbean Sea and the Gulf of Mexico. Venezuela supplied 48 percent of the total imports in 1945 and 53 percent in 1946; the Netherlands West Indies 41 percent in 1945 and 34 percent in 1946; Colombia 6 percent in 1945 and 7 percent in 1946; and Mexico 3 percent in 1945 and 4 percent in 1946.

Of the crude petroleum imported into continental United States, Venezuela furnished 77 percent of the total in 1945 and 81 percent in 1946, Netherlands West Indies 7 percent in 1945 and 6 percent in 1946, Colombia 11 percent in 1945 and 12 percent in 1946, and Mexico 3 percent both in 1945 and in 1946. Kuwait, a newcomer in the United States market, made an initial shipment of 115,000 barrels in 1946.

The Netherlands West Indies provided 97 percent of the residual fuel oil imported into continental United States and the noncontiguous Territories in 1945 and 95 percent in 1946. Minor amounts were imported in both years from Mexico, Venezuela, Trinidad, Canada, and Colombia.

[3] By A. H. Redfield, Petroleum Economics Branch, Bureau of Mines.

Mineral oils, crude and refined, imported into continental United States, 1945–46, by months [1]

[Thousands of barrels]

Class	January	February	March	April	May	June	July	August	September	October	November	December	Total
1945													
Crude petroleum	3,969	3,939	6,197	5,151	6,621	5,620	7,601	7,230	5,759	7,347	7,395	7,508	74,337
Refined products:													
Gasoline, finished	141	201	110	87	299	352	142	202	69	105	99		1,807
Distillate fuel oil	6	218	649	758	647	417	192	264	217	239	596	551	4,754
Residual fuel oil	2,773	2,247	3,862	3,249	2,808	3,184	2,011	1,894	1,270	2,490	3,473	2,387	31,648
Paraffin wax				1			1	2	1	1			6
Asphalt	46	3		125	89	102	46	47	130	39	182		809
Unfinished oils, other										67		191	258
	6,935	6,608	10,818	9,371	10,464	9,675	9,993	9,639	7,446	10,288	11,745	10,637	113,619
1946 [2]													
Crude petroleum	6,917	6,787	6,812	7,466	7,508	6,880	6,978	8,296	7,508	7,001	6,852	7,061	86,066
Refined products:													
Gasoline, finished												1	1
Distillate fuel oil	582	480	528	251	674	342	605	507	408	330	264	170	5,141
Residual fuel oil	3,768	3,336	2,735	1,883	3,794	3,659	3,325	3,487	3,932	3,323	3,804	5,021	42,067
Lubricating oil						13	11	27	1	12	2	22	88
Paraffin wax							1						1
Asphalt	50	4	54	110	40	81	50	103	153	46			691
Unfinished oils, other	110	91	36	55	159	143	75	94		20	145	50	978
	11,427	10,698	10,165	9,765	12,175	11,118	11,045	12,514	12,002	10,732	11,067	12,325	135,033

[1] Imports of crude as reported to Bureau of Mines; imports of refined products compiled from records of U. S. Department of Commerce; figures may differ slightly from those used throughout other sections of this report.

[2] Subject to revision.

Caribbean countries and Mexico shipped 77 percent of the distillate fuel oil received in continental United States and the noncontiguous Territories in 1946, and Middle Eastern countries—Saudi Arabia, Bahrein Island, and Iran—23 percent. In 1945 Caribbean countries and Mexico had supplied 98 percent of these imports.

EXPORTS

Continental United States continued to be a net exporter of mineral oils. The excess of all petroleum exports over all petroleum imports decreased from 69 million barrels (revised figure) in 1945 to 16 million barrels in 1946. In crude petroleum, however, imports were larger than exports in both years. The excess of crude imports increased from 41 million barrels (revised figure) in 1945 to 45 million barrels in 1946. The principal decreases were in net exports of refined oils, notably of motor fuel (from 86 million in 1945 to 45 million in 1946), and of distillate fuel oil (from 29 million barrels in 1945 to 24 million in 1946). On the other hand, residual fuel oil has long been imported in greater quantities than exported. The excess of imports of residual fuel oil increased from 20 million barrels in 1945 to 33 million barrels in 1946. The net outward shipments of lubricating oils increased from 7 million barrels in 1945 to 11 million barrels in 1946, reflecting the resumption of manufacturing activities in Europe.

Exports and Territorial shipments of crude petroleum from continental United States increased 23 percent from 1945 to 1946; but the 40,750,000 barrels of crude petroleum exported and shipped to the Territories in 1946 was only 53 percent of the 77,273,000 barrels exported and shipped in 1938, the peak year for such outward shipments. There was a marked difference in the destinations of the crude exports in the two sample years. In 1938 Canada received 32 percent of the total exports of crude, Japan 27 percent, France 22 percent, and Italy 9 percent. In 1946, however, 86 percent of the crude exports went to Canada, 5 percent to France, 3 percent to the United Kingdom, and 3 percent to Cuba.

Exports and Territorial shipments of refined oils were 26 percent less in 1946 than in 1945. The greatest decrease, both quantitatively and proportionally, was in outward shipments of motor fuel, which declined 48 percent from 1945 to 1946, largely as a result of the termination of Lend-Lease shipments. The most marked decline was in exports of motor fuel to Europe, especially to the United Kingdom and the U. S. S. R. Exports and Territorial shipments of distillate fuel oil were 12 percent lower in 1946 than in 1945, chiefly as a result of decreased exports to the United Kingdom; and of residual fuel oil were 19 percent less in 1946 than in 1945, likewise due to reduced shipments to the United Kingdom. On the other hand, the

Crude petroleum exported from the United States, 1939–46, by countries [1]

[Thousands of barrels]

	1939	1940	1941	1942	1943	1944	1945	1946
Canada	28,121	28,778	26,516	33,753	41,942	33,738	32,841	36,595
Cuba	1,141	822	1,219	825	791	574	824	1,158
Mexico	290	349	195	103	65	60	80	102
Argentina	2,125	779	423	113			70	724
Brazil	173	250	273	69	2	1	73	282
Colombia				85				1
Chile	46	30						
Belgium	279							68
Denmark	211							
France	14,955	5,420						2,305
Germany	416							
Italy	4,985	1,420						
Netherlands	276							
Portugal	140	531	69				1	
Sweden	639	46					104	87
United Kingdom	560	533	238	598	485	421	1,284	1,233
India					34			3
China	89		5					
Kwantung	818	844	324					
Hong Kong	191							
Japan	16,086	11,529	5,208					
Siam	232	91						
British East Africa					1		1	
Egypt					6	5		
Gold Coast					3			
Union of South Africa	85			1	1		2	2
Australia		9	7	1				
New Zealand					3			8
Other countries	218	65	7	12	10	3	73	6
	72,076	51,496	34,484	35,560	43,343	34,802	35,353	42,574

[1] U. S. Department of Commerce.

outside world took 38 percent more kerosine from the United States in 1946 than in 1945 and 68 percent more lubricating oils. Exports and Territorial shipments of paraffin wax increased 27 percent from 1945 to 1946, partly at least because of the virtual elimination of Burma and Indonesia from the export market.

Of the total exports and Territorial shipments of major refined oils and paraffin wax to foreign countries, 77 percent in 1945 and 59 percent in 1946 went to Europe. The United Kingdom received 69 percent of the total in 1945 but only 31 percent in 1946, and the U. S. S. R. 4 percent in 1945 and 2 percent in 1946. To other European countries that had been largely deprived of mineral oils during the war period, 4 percent went in 1945 but 26 percent in 1946.

North American countries received 6 percent of the total exports and Territorial shipments in 1945 but 15 percent in 1946. Canada's share of the whole increased from 3 percent in 1945 to 9 percent in 1946. South America took 1 percent of the total in 1945 and 2 percent in 1946.

Exports and Territorial shipments of major refined oils and wax from the United States to Oceania amounted to 2 percent of the total foreign sales in 1945 and 4 percent in 1946. Australia received 1½ percent of the whole in 1945 and 2 percent in 1946.

Africa accounted for 2 percent of the total exports and Territorial shipments of refined oils and wax in 1945 and for 4 percent in 1946.

Mineral oils, crude and refined, shipped from continental United States, including shipments to noncontiguous Territories, 1945–46, by classes and months [1]

[Thousands of barrels]

Class	January	February	March	April	May	June	July	August	September	October	November	December	Total
1945													
Crude petroleum	1,302	1,599	1,973	2,663	3,208	2,915	3,533	3,308	3,166	3,603	3,399	2,329	32,998
Refined products:													
Motor fuel [2]	9,718	7,655	12,359	12,561	11,680	9,903	6,436	2,899	4,439	2,449	2,958	5,002	88,059
Kerosine	191	296	476	412	656	571	568	549	824	626	534	477	6,180
Distillate fuel oil	2,429	1,760	2,549	3,119	4,127	4,913	3,358	2,182	1,604	2,619	2,648	2,188	33,496
Residual fuel oil	1,143	511	1,370	1,298	1,285	1,145	1,563	890	621	599	497	747	11,669
Lubricating oil	438	425	554	562	789	693	828	407	465	307	579	528	6,575
Paraffin wax	70	55	54	37	32	31	27	36	50	46	59	69	566
Coke	36	58	84	93	106	86	64	100	73	110	137	99	1,046
Asphalt	118	57	86	95	108	80	69	104	143	137	154	138	1,289
Miscellaneous oils	87	88	93	70	88	87	82	91	74	98	125	122	1,105
Total refined	14,230	10,905	17,625	18,247	18,871	17,509	12,995	7,258	8,293	6,991	7,691	9,370	149,985
Total crude and refined	15,532	12,504	19,598	20,910	22,079	20,424	16,528	10,566	11,459	10,594	11,090	11,699	182,983
1946 [3]													
Total crude and refined	1,932	1,997	2,720	3,618	3,614	3,323	4,290	4,368	4,152	4,244	3,325	3,167	40,750
Refined products:													
Motor fuel [2]	5,473	4,616	5,390	3,533	3,038	2,860	2,752	3,948	3,936	2,675	3,230	3,938	45,389
Kerosine	603	380	402	701	800	1,614	1,011	803	748	337	444	716	8,559
Distillate fuel oil	2,540	1,885	1,854	3,606	4,147	4,115	2,738	3,018	2,064	1,028	877	1,481	29,353
Residual fuel oil	753	794	973	856	532	566	931	666	1,039	811	514	1,051	9,486
Lubricating oil	785	612	1,239	731	1,143	1,067	924	1,150	708	709	913	1,077	11,058
Paraffin wax	73	48	53	58	58	69	56	60	54	26	79	84	718
Coke	96	132	145	109	192	393	130	158	77	108	198	193	1,931
Asphalt	203	209	197	111	253	233	137	148	95	54	240	168	2,048
Miscellaneous oils	145	156	81	161	149	193	211	191	147	127	146	205	1,912
Total refined	10,671	8,832	10,334	9,866	10,312	11,110	8,890	10,142	8,868	5,875	6,641	8,913	110,454
Total crude and refined	12,603	10,829	13,054	13,484	13,926	14,433	13,180	14,510	13,020	10,119	9,966	12,080	151,204

[1] Exports of crude as reported to Bureau of Mines; export and shipments of refined products compiled from records of U. S. Department of Commerce; figures may differ slightly from those used throughout other sections of this report.
[2] Includes benzol, natural gasoline, and antiknock compounds.
[3] Subject to revision.

Major petroleum products exported from continental United States, by countries of destination, and shipments to and exports from noncontiguous Territories, 1944–46 [1]

[Thousands of barrels, except wax, which is in thousands of pounds]

Country	Motor fuel [2]			Kerosine			Fuel oil			Lubricating oil			Wax		
	1944	1945	1946	1944	1945	1946	1944	1945	1946	1944	1945	1946	1944	1945	1946
North America:															
Bermuda	(3)	16	(3)	(3)	(3)	(3)	(3)		(3)	2	2	2	1	(4)	(4)
Canada	2,522	2,329	4,734	186	241	602	2,210	1,560	3,573	383	292	303	19,431	24,273	31,776
Canal Zone	72	2	18	(3)	(3)			219	227	10	20	7			7
Cuba	271	436	833	2	1	(3)	2,343	1,064	1,304	57	68	79	4,250	2,644	3,126
Curacao (N. W. I.)	(3)	(3)	(3)				1	(3)	(3)	13	10	23	1	1	(4)
Iceland	2	119	(3)					9		10	12	8	85	53	57
Mexico	636	812	1,504	86	118	145	833	825	1,255	192	271	240	1,804	8,131	3,975
Trinidad and Tobago	(3)	(3)	(3)	(3)				(3)		13	16	17	24	120	116
Other North America	66	104	415	22	24	63	47	64	197	68	86	95	6,822	4,023	6,152
	3,569	3,818	7,504	296	384	810	5,434	3,741	6,556	748	777	774	32,418	39,245	45,209
South America:															
Argentina	(3)	1	10	(3)	1	1	52	170	178	12	23	53		334	2,342
Bolivia	3	7	7	1	(3)	(3)	1	(3)	(3)	17	8	14	3,287	2,205	2,258
Brazil	30	254	773	4	8	65		18	100	492	417	364	3,856	4,014	3,088
Chile	18	22	7	1	1	(3)	9	1	90	76	76	90	10,422	14,423	8,395
Colombia	(3)	(3)	19		(3)	(3)				29	35	39	12,732	12,681	15,284
Peru	4	32	1	(3)	(3)				1	34	25	41	7,408	6,241	3,210
Surinam	(3)	(3)	(4)	4		(3)				2	2	2	9	5	13
Uruguay	2	7	110	(3)	(3)	34				20	27	52	502	679	433
Venezuela	1	2	1					(3)	1	61	105	93	5,641	1,688	3,656
Other South America	(3)	3	7	3				2		16	19	23	2,460	2,366	2,035
	58	328	935	13	10	100	62	191	370	759	737	771	46,317	44,636	40,714
Europe:															
Belgium and Luxembourg		147	963		(3)	33		183	576		32	881			6,053
Eire	66	(3)	(3)				30			5	1	1	1,518	526	738
France		1,898	5,489		150	341		699	2,234		102	1,284		539	6,801
Netherlands		263	1,069		103	847		48	744		1	316		(4)	5,725
Norway		(3)	628			42		100	64		(3)	109		654	2,211
Portugal	1	(3)	53	(3)	(3)	100	(3)			40	67	89	721	1,704	1,712
Spain		(3)	874			75			275	73	103	294	559	1,872	461
Sweden	(3)	555	1,328		56	380	67	671	1,761	65	145	487	580	1,282	8,269
Switzerland		1	138					223	199		21	129		331	4,236
U. S. S. R.	4,576	4,581	488	39	51	20	312	1,210	1,950	250	268	57	1,273	26	

See footnotes at end of table.

Major petroleum products exported from continental United States, by countries of destination, and shipments to and exports from noncontiguous Territories, 1944–46 [1]—Continued

[Thousands of barrels, except wax, which is in thousands of pounds]

Country	Motor fuel [2]			Kerosine			Fuel oil			Lubricating oil			Wax		
	1944	1945	1946	1944	1945	1946	1944	1945	1946	1944	1945	1946	1944	1945	1946
Europe—Continued															
United Kingdom	75,886	62,092	12,602	4,278	4,984	3,013	43,700	31,272	14,399	3,833	1,862	1,989	64,544	60,060	49,739
Other Europe	(3)	9	2,586	-------	5	449	-------	99	1,536	13	2	560	(4)	38	5,245
	80,529	69,546	26,218	4,317	5,349	5,300	44,109	34,505	23,738	4,279	2,604	6,196	69,195	67,032	91,190
Asia:															
Ceylon	3,769	7,211	-------	-------	(3)	-------	-------	(3)	-------	37	49	27	-------	-------	-------
China and Hong Kong	1	121	1,675	-------	38	876	-------	23	835	1	28	599	-------	-------	11,048
India	2,271	1,158	(3)	(3)	-------	(3)	-------	(3)	-------	571	917	537	261	57	1
Iran	(3)	(3)	-------	-------	-------	-------	-------	-------	-------	17	28	2	-------	1	-------
Iraq	-------	-------	(3)	-------	-------	-------	-------	-------	-------	35	39	15	-------	-------	-------
Philippines, Republic of	-------	(3)	267	-------	-------	275	-------	-------	91	-------	1	132	-------	574	2,054
Turkey	(3)	(3)	146	-------	(3)	41	-------	-------	1	38	51	75	344	587	1,094
Other Asia	(3)	2	82	(3)	1	23	-------	16	48	46	66	251	28	260	465
	6,041	8,492	2,170	(3)	39	1,215	-------	39	975	745	1,179	1,638	633	1,479	14,662
Africa:															
Algeria	(3)	247	250	-------	-------	85	-------	196	283	(3)	(3)	64	-------	18	1,501
Belgian Congo	(3)	1	(3)	-------	-------	1	-------	-------	2	30	24	32	209	4	40
Egypt	2,265	1,308	(3)	(3)	(3)	(3)	-------	-------	-------	304	191	209	155	351	93
Gold Coast	95	(3)	(3)	9	-------	-------	11	-------	-------	18	14	17	-------	6	-------
Liberia	(3)	(3)	3	-------	1	1	-------	-------	(3)	-------	1	2	97	103	178
Morocco	-------	124	723	-------	27	326	-------	174	411	(3)	(3)	22	7	(4)	562
Nigeria	70	(3)	(3)	1	(3)	-------	-------	-------	-------	17	11	15	-------	1	1
Southern Rhodesia	-------	-------	4	-------	(3)	1	-------	-------	-------	34	16	8	(4)	45	-------
Union of South Africa	1	4	1,016	(3)	18	37	-------	-------	-------	367	261	332	8,597	5	3,993
Other Africa	46	6	488	14	3	9	28	3	3	184	127	199	288	318	932
	2,477	1,690	2,484	24	49	460	39	373	699	954	645	900	9,353	851	7,300
Oceania:															
Australia	3,549	1,788	1,711	-------	53	206	748	6	61	977	389	517	4,283	3,266	1,297
British Oceania (other)	-------	14	93	12	15	4	(3)	34	61	3	5	4	-------	-------	-------
New Guinea (Australian)	2,066	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	(3)	-------	-------	-------

New Zealand	156	336	786	2	15	86	445	17	544	95	94	121	45	1,793	353
Other Oceania	18	24	62	6	9	6	4	6	15	2	2	2	----	(4)	----
	5,789	2,162	2,652	20	92	302	1,197	63	681	1,077	490	644	4,328	5,059	1,650
	98,463	86,036	41,963	4,670	5,923	8,187	50,841	38,912	33,019	8,562	6,432	10,923	162,244	158,302	200,725
Shipments from continental United States to noncontiguous Territories:															
Alaska	361	327	508	----	----	----	1,105	1,004	1,216	33	30	23	----	----	----
Hawaii	1,691	1,547	1,533	213	204	160	4,091	5,235	4,298	107	64	52	84	117	175
Puerto Rico	1	143	1,431	(3)	45	313	----	17	194	81	47	34	77	109	242
Virgin Islands	41	20	20	7	6	7	8	5	7	1	1	(3)	----	----	----
Other	(3)	1	(3)	(3)	1	(3)	----	----	(3)	(3)	(3)	(3)	----	----	5
	2,094	2,038	3,492	220	256	480	5,204	6,261	5,715	222	142	109	161	226	422
Exports from noncontiguous Territories to foreign countries:															
Alaska	5	13	29	(3)	(3)	(3)	6	6	45	(3)	(3)	(3)	----	----	----
Hawaii	----	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	----	(3)	----	----	----
Puerto Rico	8	2	81	2	----	22	9	4	15	(3)	(3)	(3)	----	----	35
	13	15	110	2	(3)	22	15	10	60	(3)	(3)	(3)	----	----	35
Total net shipments from continental United States	100.544	88,059	45,345	4,888	6,179	8,645	56,030	45,163	38,674	8,784	6,574	11,032	162,405	158.528	201,112

[1] Compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.
[2] Includes natural gasoline, naphtha, benzol, and antiknock compounds.
[3] Less than 1,000 barrels.
[4] Less than 1,000 pounds.

793065—48——63

WORLD PRODUCTION [4]

The world production of crude petroleum continued its upward trend, increasing 6 percent in 1946 over 1945 and attaining a new high. The United States production increased only 1 percent from 1945 to 1946, but other countries enlarged their output 16 percent.

The Western Hemisphere contributed 82 percent of the total world petroleum production in 1946. The United States alone supplied 63 percent of the world output and Venezuela 14 percent. In the Eastern Hemisphere, the U. S. S. R. furnished 6 percent of the world total, so far as unsatisfactory statistics would indicate, and Iran 5 percent.

Crude petroleum produced in principal countries of the world, 1941–46, in thousands of barrels

[Compiled by B. B. Mitchell]

Country	1941	1942	1943	1944	1945	1946
North America:						
Canada	10,134	10,365	10,052	10,099	8,483	7,668
Mexico	42,196	34,815	35,163	38,203	43,547	49,235
Trinidad	20,506	22,069	21,385	22,139	21,093	20,233
United States	1,402,228	1,386,645	1,505,613	1,677,904	1,713,655	1,733,424
Other North America [1]	150	150	150	150	150	150
Total North America	1,475,214	1,454,044	1,572,363	1,748,495	1,786,928	1,810,710
South America:						
Argentina	21,873	23,704	27,714	24,230	22,881	20,604
Bolivia	235	308	334	314	382	363
Brazil	3	33	48	58	79	67
Columbia	24,553	10,487	13,261	22,291	22,449	22,118
Ecuador	1,557	2,278	2,315	2,967	2,664	2,323
Peru	11,935	13,629	14,654	14,386	13,744	12,456
Venezuela	228,430	147,675	177,631	257,046	323,156	388,486
Total South America	288,586	198,114	235,957	321,292	385,355	446,417
Europe:						
Albania	1,334	1,601	1,001	334	267	365
Austria	4,238	5,899	7,478	8,218	3,074	5,734
Czechoslovakia	183	271	[1] 200	[1] 185	[1] 170	[1] 156
France	414	463	[1] 356	[1] 300	197	367
Germany	6,303	5,191	4,973	5,049	[1] 3,800	[1] 4,500
Hungary [2]	3,183	5,037	6,347	6,204	5,018	5,146
Italy	95	101	[1] 75	[1] 75	[1] 75	76
Netherlands			(3)	14	41	10
Poland	1,793	2,794	[1] 3,500	[1] 3,000	[4] 750	[4] 860
Rumania	40,517	42,094	39,182	26,191	34,772	31,206
U. S. S. R. [1 5]	238,150	227,470	200,750	275,000	148,953	164,000
United Kingdom	223	605	839	703	532	412
Other Europe [1]	10	10	10	10	10	10
Total Europe [5]	296,443	291,536	264,711	325,283	197,659	212,842
Asia:						
Bahrein Island	6,794	6,241	6,572	6,714	7,309	8,010
Burma	7,762	2,500	1,000	[1] 750	[1] 725	[1] 700
China	87	340	447	505	484	513
Formosa	62	48	38	40	11	16
India	2,899	2,792	2,735	2,784	2,343	2,193
Iran (Persia)	50,777	72,256	74,612	102,045	130,526	146,614
Iraq	12,650	19,726	24,848	30,943	35,112	35,665
Japan	1,929	1,652	1,727	1,601	1,510	1,343
Kuwait						5,931
Netherlands Indies	53,704	24,000	48,294	22,260	7,600	2,100
Sakhalin [1]	4,000	4,000	5,000	5,000	6,000	6,000

See footnotes at end of table.

[4] By A. H. Redfield, Petroleum Economics Branch, Bureau of Mines.

Crude petroleum produced in principal countries of the world, 1941–46, in thousands of barrels—Continued

Country	1941	1942	1943	1944	1945	1946
Asia—Continued						
Sarawak and Brunei	6,864	[1] 3,000	[1] 4,500	[1] 6,000	2,100	2,100
Saudi Arabia	4,310	4,530	4,868	7,794	21,311	59,944
Total Asia[6]	151,838	141,085	174,641	186,436	215,031	271,129
Africa:						
Egypt	8,546	8,275	8,953	9,416	9,406	9,070
Other Africa [1]	27	27	25	30	25	20
Total Africa	8,573	8,302	8,978	9,446	9,431	9,090
Oceania: New Zealand	3	2	2	2	3	2
World total	2,220,657	2,093,083	2,256,652	2,590,954	2,594,407	2,750,190

[1] Estimate.
[2] Includes Northern Territories, Sub-Carpathia, Eastern Hungary, and Transylvania; and beginning in 1942 includes Southern Territories.
[3] Data not available.
[4] Postwar borders.
[5] Includes U. S. S. R. fields in Asia, other than Sakhalin.
[6] Exclusive of U. S. S. R. fields in Asia (other than Sakhalin), which are included with U. S. S. R. in Europe.

In the Western Hemisphere, Venezuela had the largest increase in petroleum production—20 percent from 1945 to 1946. Other South American countries showed slight decreases, owing largely to difficulties in obtaining pipe and drilling equipment. Mexico definitely increased its petroleum production in 1946 over 1945. Trinidad produced a little less in 1946 than in 1945; and Canadian production in 1946 was lower than in any year since 1939.

Petroleum production in Europe showed a combination of recovery from war damages and of decline in the output of old and partly exhausted fields. Rumania, the largest European producer outside the U. S. S. R., produced 10 percent less oil in 1946 than in 1945. However, increased petroleum production in Germany, Hungary, Austria, and other countries offset the decline in Rumania.

The Middle East showed the largest proportional increase in petroleum production, enlarging its collective output 32 percent from 1945 to 1946. Its share of the world total increased from 7 percent in 1945 to 9 percent in 1946. Production in Iraq, limited by the fixed capacity of the pipe line from Kirkuk to the Mediterranean, was less than 2 percent larger in 1946 than in 1945. On the other hand, Iran increased its output 12 percent in 1946 over 1945, and Saudi Arabia in 1946 nearly trebled its 1945 production. Bahrein Island showed a 10-percent increase. Kuwait began commercial production in 1946.

In Far Eastern Asia, the Netherlands East Indies, troubled by domestic strife and political uncertainty, produced in 1946 only a small fraction of its prewar output. Repair of war damage retarded oil production in Burma. Japanese output was lower in 1946 than in 1945. India likewise produced less petroleum in 1946 than in 1945.

Statistically speaking, the U. S. S. R. remained a great enigma. Only a few brief statements in the Soviet press gave any indication of petroleum developments in this vast country during 1945 and 1946.

Phosphate Rock

By BERTRAND L. JOHNSON AND E. M. TUCKER

GENERAL SUMMARY

DEMAND for phosphate rock in recent years has been abnormally high (see fig. 1), and the upward trend continues. New records were made in the domestic phosphate-rock industry in 1946, according to reports submitted by operators to the Bureau of Mines. Total mine production reached a new high at 7,168,839 long tons. Phosphate rock sold or used by producers in 1946 also attained a new peak of 6,860,713 long tons containing 2,216,978 long tons of P_2O_5, valued at $31,043,821, which is over $7,000,000 more than the 1945 total. The marketed production from Florida and the Western States in 1946 was greater than ever before, and the quantity of Tennessee phosphate rock sold or used (although not a record) was greater than in 1945. Imports declined; exports increased 29 percent. Apparent domestic consumption in 1946 rose to 6,287,112 long tons (see footnote to apparent consumption table).

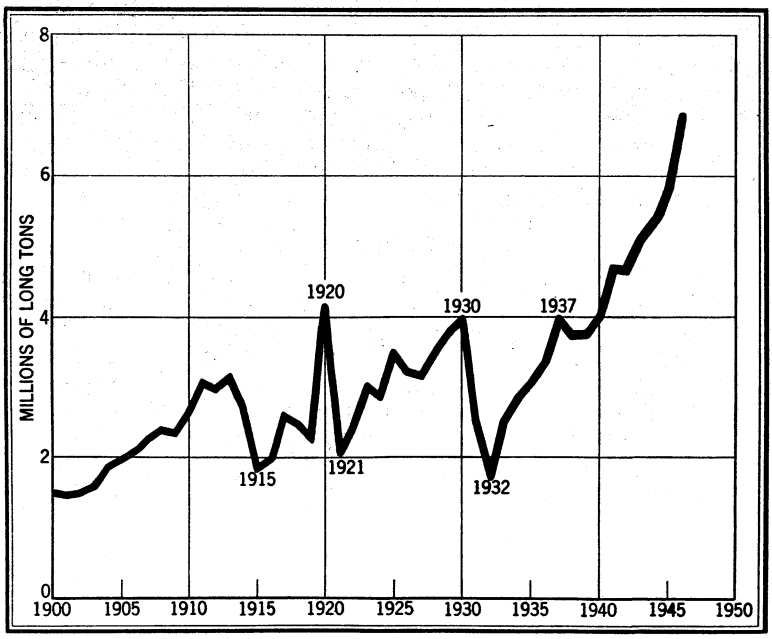

FIGURE 1.—Marketed production of domestic phosphate rock, 1900–46.

Salient statistics of the phosphate-rock industry in the United States, 1945–46

	1945				1946			
	Long tons		Value at mines		Long tons		Value at mines	
	Rock	P_2O_5 content	Total	Average	Rock	P_2O_5 content	Total	Average
Production (mined)	5,399,739	1,737,185	(1)	(1)	7,168,839	2,316,471	(1)	(1)
Sold or used by producers:								
Florida:								
Land pebble	4,103,022	1,382,950	$15,578,980	$3.80	4,807,563	1,615,919	$19,867,339	$4.13
Soft rock	71,715	15,050	293,433	4.09	97,067	19,652	387,708	3.99
Hard rock	63,491	22,613	426,061	6.71	100,881	36,627	762,127	7.55
Total Florida	4,238,228	1,420,613	16,298,474	3.85	5,005,511	1,672,198	21,017,174	4.20
Tennessee [2 3]	1,294,297	375,370	6,062,688	4.68	1,362,600	389,204	7,014,490	5.15
Idaho	123,340	38,984	673,627	5.46	[4] 312,658	[4] 97,964	[4] 1,805,103	[4] 5.77
Montana	150,858	49,068	916,288	6.07	179,944	57,522	1,207,054	6.71
Utah					(4)	(4)	(4)	(4)
Total United States	5,806,723	1,884,035	23,951,077	4.12	6,860,713	2,216,978	31,043,821	4.52
Imports [5]	141,658	(1)	1,112,526	7.85	59,739	(1)	601,683	10.07
Exports [6]	490,733	(1)	3,737,080	7.62	633,340	(1)	5,453,361	8.61
Apparent consumption [8]	[7]5,457,648	(1)			6,287,112	(1)		
Stocks in producers' hands, December 31:								
Florida	388,000	129,000	(1)	(1)	630,000	210,000	(1)	(1)
Tennessee [2 3 9]	411,000	113,000	(1)	(1)	464,000	125,000	(1)	(1)
Western States	47,000	15,000	(1)	(1)	117,000	38,000	(1)	(1)
Total stocks	846,000	257,000	(1)	(1)	1,211,000	373,000	(1)	(1)

[1] Data not available.
[2] Includes sintered matrix.
[3] Includes small quantity from Virginia.
[4] Utah included with Idaho.
[5] Market value (or price) at port and time of exportation to the United States.
[6] Value at port of exportation. Export figures exclude Army shipments to occupied territories.
[7] Revised.
[8] Quantity sold or used by producers plus imports minus commercial exports.
[9] Includes brown-rock matrix of sinter grade, sintered brown rock, blue rock, and some matrix of washer grade.

Several general papers relating to the phosphate-rock industry have been published recently.[1]

A report containing data gathered by the Federal Trade Commission in its investigation, under the Webb-Pomerene Export Act, of international phosphate cartels was submitted by that Commission to Congress early in 1946.[2]

[1] U. S. Department of Agriculture, Fertilizers and Lime in the United States—Resources, Production, Marketing, and Use: Misc. Pub. 586, 1946, 94 pp.
Johnson, Bertrand L., The Phosphate Rock Industry: Min. Cong. Jour., vol. 33, No. 2, February 1947, pp. 107–109.
Prentiss, A. M., and Waggaman, W. H., Phosphorus—Creator and Destroyer: Chemistry, vol. 19, No. 11, July 1946, pp. 1–10.
Monsanto Chemical Co., Phosphorus—the Light Bearer, St. Louis, Mo., 1946, 24 pp.
Odishaw, Hugh, The Mining and Processing of Phosphate: Westinghouse Eng., vol. 6, No. 4, July 1946, pp. 111–116.

[2] Federal Trade Commission, Report on international phosphate cartels: 1946, 60 pp.

PRODUCTION

Again a new record has been made in the quantity of phosphate rock mined in the United States. In 1946, 7,168,839 long tons came from domestic mines, nearly 2,000,000 tons more than in 1945. Increases were recorded in Florida, Tennessee, and the Western States, new highs being reached in Florida and the Western States. Tennessee showed an increase in 1946 over 1945, but the production was below that of some previous years. Phosphate rock was mined in 1946 in Florida, Tennessee, Idaho, Montana, and Utah, and apatite in Virginia.

Phosphate rock mined in the United States, 1937–46, by States, in long tons

Year	Florida	Tennessee [1]	Western States	United States	Year	Florida	Tennessee [1]	Western States	United States
1937	3,179,588	942,158	139,670	4,261,416	1942	2,984,503	1,568,162	266,273	4,818,938
1938	2,722,927	999,551	137,998	3,860,476	1943	3,274,266	1,868,407	227,294	5,369,967
1939	2,791,360	1,057,570	139,040	3,987,970	1944	3,486,482	1,413,246	300,274	5,200,002
1940	2,782,956	1,120,551	164,570	4,068,077	1945	3,814,935	1,260,849	323,955	5,399,739
1941	3,417,900	1,301,067	203,216	4,922,183	1946	5,280,402	1,316,107	572,330	7,168,839

[1] Includes small quantity of apatite from Virginia and in 1938 small quantity of phosphate rock from South Carolina. Includes in 1938–43 some matrix of washer grade.

SALES

In 1946, another record was also made in the quantity of phosphate rock sold or used by producers—6,860,713 long tons—which exceeded the previous record, made in 1945, by over a million tons. The total value of $31,043,821 was more than $7,000,000 greater than in 1945, owing partly to the larger sales and partly to the higher average value per ton, which increased from $4.12 in 1945 to $4.52 in 1946.

Phosphate rock sold or used by producers in the United States, 1942–46

Year	Long tons	Value at mines		Year	Long tons	Value at mines	
		Total	Average			Total	Average
1942	4,644,240	$16,597,492	$3.57	1945	5,806,723	$23,951,077	$4.12
1943	5,126,232	18,962,021	3.70	1946	6,860,713	31,043,821	4.52
1944	5,376,643	20,856,429	3.88				

The following table shows sales of phosphate rock, by grades, for 1945 and 1946. For the first time these data are shown separately for Florida, Tennessee, and the Western States, as well as for the United States as a whole.

Phosphate rock sold or used by producers in the United States, 1945–46, by grades and States

Grades—B. P. L.[1] content (percent)	Florida		Tennessee[2]		Western States		United States	
	Long tons	Percent of total	Long tons	Percent of total	Long tons	Percent of total	Long tons	Percent of total
1945								
Below 60	71,829	2	451,690	35	61	(3)	523,580	9
60 to 66	3,138	(3)	264,779	20	336	(3)	268,253	5
68 basis, 66 minimum	161,534	4	173,914	13	112,434	41	447,882	8
70 minimum	821,956	19	84,311	7	10,246	4	916,513	16
72 minimum	927,769	22	313,088	24	10,570	4	1,251,427	21
75 basis, 74 minimum	1,177,135	28	151	(3)			1,177,286	20
77 basis, 76 minimum	895,561	21	253	(3)			895,814	15
Above 85 (apatite) Undistributed	179,306	4	6,111	1	140,551	51	325,968	6
	4,238,228	100	1,294,297	100	274,198	100	5,806,723	100
1946								
Below 60	100,938	2	637,053	47	2,433	1	740,424	11
60 to 66	18,759	(3)	286,416	21			305,175	4
68 basis, 66 minimum	213,556	4	32,581	2	203,857	41	449,994	7
70 minimum	838,290	17	220,299	16	357	(3)	1,058,946	15
72 minimum	1,150,749	23	184,857	14	283,899	58	1,619,505	24
75 basis, 74 minimum	1,448,156	29			2,056	(3)	1,450,212	21
77 basis, 76 minimum	1,077,158	22	501	(3)			1,077,659	16
Above 85 (apatite) Undistributed	157,905	3	893	(3)			158,798	2
	5,005,511	100	1,362,600	100	492,602	100	6,860,713	100

[1] Bone phosphate of lime.
[2] Includes a small quantity from Virginia.
[3] Less than 0.5 percent.

CONSUMPTION AND USES

Apparent consumption of phosphate rock in the United States in 1946 increased to 6,287,112 tons, continuing the wartime expansion of domestic demand for this material.

Apparent consumption[1] of phosphate rock in the United States, 1942–46, in long tons

Year	Long tons	Year	Long tons
1942	4,119,289	1945	5,457,648
1943	4,814,727	1946	6,287,112
1944	5,061,924		

[1] Quantity sold or used by producers plus imports minus commercial exports; Army shipments to occupied territories not considered.

Data on sales of phosphate rock by uses are shown in the accompanying table; separate figures for Florida, Tennessee, and Western States are shown for the first time.

Phosphate rock sold or used by producers in the United States, 1945–46, by uses and States

Uses	Florida		Tennessee [1]		Western States		United States	
	Long tons	Percent of total	Long tons	Percent of total	Long tons	Percent of total	Long tons	Percent of total
1945								
Domestic:								
Superphosphates	3,387,641	80	424,750	33	133,876	49	[2] 3,946,267	68
Phosphates, phosphoric acid, phosphorus, ferrophosphorus	209,176	5	649,037	50	5,388	2	[2] 863,601	15
Direct application to soil	213,560	5	196,228	15	1,855	1	411,643	7
Fertilizer filler	9,813	(3)	4,680	1	------	------	14,493	(3)
Stock and poultry feed	61,551	2	1,974		------	------	63,525	1
Undistributed [4]	------	------	17,628	1	------	------	[2] 17,628	(3)
Exports [5]	356,487	8	------	------	133,079	48	489,566	9
	4,238,228	100	1,294,297	100	274,198	100	5,806,723	100
1946								
Domestic:								
Superphosphates	3,959,108	79	449,496	33	195,838	40	4,604,442	67
Phosphates, phosphoric acid, phosphorus, ferrophosphorus	231,338	5	653,885	48	9,278	2	894,501	13
Direct application to soil	314,575	6	212,405	16	1,117	(3)	528,097	8
Fertilizer filler	32,303	1	18,454	1	------	------	50,757	1
Stock and poultry feed	52,501	1	500	(3)	------	------	53,001	1
Undistributed [4]	1,047	(3)	27,860	2	2,081	(3)	30,988	(3)
Exports [5]	414,639	8	------	------	284,288	58	698,927	10
	5,005,511	100	1,362,600	100	492,602	100	6,860,713	100

[1] Includes a small quantity from Virginia.
[2] Revised.
[3] Less than 0.5 percent.
[4] Includes phosphate rock used in pig-iron blast furnaces, parting compounds, research, defluorinated phosphate fertilizers, refractories, and other uses.
[5] As reported to the Bureau of Mines by domestic producers.

Two-thirds of the phosphate rock produced is used in the manufacture of superphosphates for fertilizer. Certain details regarding the superphosphate industry are shown in the accompanying table. A large portion of the superphosphate production is used in the producer's plant.

Production, shipments and stocks of superphosphates (18 percent available phosphoric acid), 1942–46, in short tons

[Bureau of Census]

	1942	1943	1944	1945	1946
Production	5,144,484	6,292,955	6,692,368	7,372,104	7,847,591
Shipments	3,961,362	3,935,293	3,951,402	4,332,992	4,421,670
Stocks in manufacturers' hands December 31	[1] 973,224	791,385	794,778	808,027	646,278

[1] Shown as 1,008,139 tons January 1, 1943.

PRICES

During most of 1946 the maximum prices of Florida land-pebble phosphate rock, Florida hard-rock phosphate, and Tennessee brown-rock phosphate for sales by miners were covered by Revised Maximum Price Regulation 240 and amendments. Prices through the early

part of the year were the same as those at the end of 1945. Effective June 19, 1946, however, new ceiling prices were placed on Florida land-pebble phosphate rock and on Tennessee brown- rock phosphate. On land pebble the price was advanced 40 cents per ton to cover an approved average wage increase of 20 cents an hour. On the Tennessee brown-rock phosphate the ceiling was raised 20 cents per ton to cover an approved wage increase of 10 cents an hour (Amendment 6 to Revised Maximum Price Regulation 240). Effective October 12, 1946, an advance of 70 cents per ton in maximum prices was granted to Florida hard-rock miners to compensate substantially for the increase in the cost of production (Amendment 7 to Revised Maximum Price Regulation 240). Ceiling prices on both Florida and Tennessee phosphate rock are shown in the accompanying table. All price controls on phosphate rock were ended November 10, 1946, by Office of Price Administration Supplementary Order 193.

Ceiling prices per long ton of Florida and Tennessee unground phosphate rock, f. o. b. cars at mines, by grades, in 1946 [1]

Grades—B. P. L.[2] content (percent)	Florida				Tennessee, Brown rock	
	Land pebble		Hard rock			
	Jan. 1 to June 18	June 19 to Nov. 10	Jan. 1 to Oct. 11	Oct. 12 to Nov. 10	Jan. 1 to June 18	June 19 to Nov. 10
68/66	$2.20	$2.60	----------	----------	$4.80	$5.00
70/68	2.60	3.00	----------	----------	5.30	5.50
72/70	3.20	3.60	$7.10	$7.80	5.80	6.00
75/74	4.20	4.60	7.85	8.55	----------	----------
77/76	5.20	5.60	8.60	9.30	----------	----------

[1] OPA Revised Maximum Price Regulation 240 and Amendments.
[2] Bone phosphate of lime.

REVIEW BY STATES

Florida.—A new record was set in 1946 in the total quantity of Florida phosphate rock sold or used—5,005,511 long tons—over three-quarters of a million tons greater than the previous record high of 1945. The total value of this rock—$21,017,174—was $1,500,000 greater than the previous record of $19,464,362, made in 1920. Increases in the quantities and values of all types of Florida rock sold or used—land-pebble, hard rock, and soft rock—were made in 1946. The total average value per ton and the average values for hard rock and land-pebble were higher in 1946 than in 1945; but the average value per ton of soft rock, as reported by the producers, was less in 1946 than in the previous year.

The land-pebble phosphate-rock mining companies in operation in 1946 were the American Agricultural Chemical Co. (Pierce); American Cyanamid Co. (Brewster); Coronet Phosphate Co. (Plant City); Davison Chemical Corp., operating the property of the former Southern Phosphate Co. during the later part of the year; International Minerals & Chemical Corp. (Mulberry); Pembroke Chemical Corp. (Pembroke); Southern Phosphate Co. (Ridgewood), during the first

part of the year; Swift & Co. Fertilizer Works (Agricola); and the Virginia-Carolina Chemical Corp. (Nichols).

Florida phosphate rock sold or used by producers, 1942–46, by kinds

Year	Hard rock			Soft rock [1]		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1942	70,014	$396,527	$5.66	48,470	$155,345	$3.20
1943	34,128	201,241	5.90	71,171	254,995	3.58
1944	22,500	138,952	6.18	60,087	259,523	4.32
1945	63,491	426,061	6.71	71,715	293,433	4.09
1946	100,881	762,127	7.55	97,067	387,708	3.99

Year	Land pebble			Total		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
1942	2,893,756	$8,826,705	$3.05	3,012,240	$9,378,577	$3.11
1933	3,483,194	11,633,241	3.34	3,588,493	12,089,477	3.37
1944	3,670,208	13,136,472	3.58	3,752,795	13,534,947	3.61
1945	4,103,022	15,578,980	3.80	4,238,228	16,298,474	3.85
1946	4,807,563	19,867,339	4.13	5,005,511	21,017,174	4.20

[1] Includes material from waste-pond operations.

The International Minerals & Chemical Corp. continued the operation of its Peace Valley mine and during the year installed at this mine the largest dragline excavator yet built, said to be the largest piece of moving machinery ever set up on land in the State of Florida. This was a huge Bucyrus-Erie walking dragline weighing 2,571,000 pounds, with a 215-foot boom and a 21.4-cubic-yard bucket. The machine is supported on a circular base 51 feet in diameter, with two walking shoes 9 feet wide and 54 feet long. The 215-foot boom is said to be 35 feet longer than any ever built before. It has a reach of 218 feet, a digging depth of 130 feet and can dump its load at a height of 80 feet. Each bucketload weighs 32 tons, and the dragline can handle 60 to 75 bucketfuls, or some 4,000,000 pounds an hour. The machine is electrically driven, with electronic controls. It contains 46 electric motors, the largest of 1,250 horsepower. A stress alarm system has been installed to warn the operator of any dangerous stress at possible points of overloading. The machine both strips the overburden and mines the phosphate-rock matrix, all operations being carried on from the surface level. A detailed description of the machine has been given by James A. Barr, Jr.[3]

At the Achan mine at Mulberry, International constructed a new plant, starting it in the spring and finishing it in August. The company will shortly open the Noralyn mine on a tract of about 1,800 acres of phosphate rock land near Bartow. This new 1,000,000-ton plant is scheduled to start operating in July 1947. Another dragline similar to the huge excavator at the Peace Valley mine has been

[3] Barr, James A., Jr., "Bigger Digger"—An Electronic Hercules: Rock Products, vol. 49, No. 11, November 1946, pp. 66–67, 69

ordered for this mine. Phosphate rock from the mine will be shipped to Mulberry, present center of the corporation's activities in Florida, where it will be graded, dried, stored, and distributed.

The Coronet Phosphate Co. in March 1946 began operation, at its Hopewell washing plant, of a 150-foot-diameter hydroseparator to secure a better separation of recoverable fine phosphate rock (14- to 150-mesh) from slime rejects in present washer debris. This machine was designed to handle 7,500 gallons per minute of washer debris, in addition to 5,000 gallons per minute of overflow from an existing 40-foot hydroseparator. This new hydroseparator does away with the use of the large settling basins formerly used at Hopewell. The operations of this company have been described in two recent articles.[4]

In August 1946 the Davison Chemical Corp., of Baltimore, Md., announced acquisition of the Florida phosphate-rock-mining properties of the Southern Phosphate Corp., these properties to be thereafter operated as the Phosphate Rock Division, Bartow, Fla., of the Davison Chemical Corp. The new division will furnish phosphate rock to the Davison plants.

In the hard-rock phosphate field, C. & J. Camp and J. Buttgenbach & Co. operated jointly, as in recent years, both mining and shipping phosphate rock. The Dunnellon Phosphate Mining Co. shipped to other mining companies some wet rock produced several years ago at its mine near Hernando. It also sold some dry rock from stock to other companies for export.

Several soft-phosphate companies recovered phosphate rock from waste ponds in the hard-rock phosphate field, and one company mined and shipped a phosphatic clay from Bartow.

Tennessee.—The tonnage of phosphate rock sold or used by Tennessee producers in 1946 (plus a small quantity of apatite from Virginia) was 1,362,600 long tons, an increase of about 5 percent over 1945, according to reports from the producing companies. Practically all of the production in 1946 was of the brown rock, although a few tons of blue rock were purchased and used by TVA. The total value of the Tennessee phosphate rock sold or used in 1946 was over $7,000,000, nearly a million dollars more than in 1945. This increase was due partly to the larger production and partly to the increase in average value per ton from $4.68 in 1945 to $5.15 in 1946.

Tennessee brown-rock phosphate was mined in 1946 by the Tennessee Valley Authority (Columbia, Tenn.) and by several private companies: Armour Fertilizer Works (Room 350, Hurt Building, Atlanta, Ga.); Federal Chemical Co. (634 Starks Building, Louisville, Ky.); Harsh Phosphate Co. (Route 1, Murfreesboro Road, Nashville, Tenn.); Hoover & Mason Phosphate Co. (8 South Michigan Avenue, Chicago, Ill.); International Minerals & Chemical Corp. (20 North Wacker Drive, Chicago, Ill.); Monsanto Chemical Co. (1700 South Second Street, St. Louis, Mo.); and Virginia Carolina Chemical Corp. (Richmond, Va.). Sales of blue rock are reported to have been made by George E. Sloan, Columbia, Tenn.

[4] Gisler, H. J., Phosphate Mining and Concentration at Coronet Phosphate Company: Deco Trefoil, June 1946, pp. 3–10.
Avery, W. M., Hydroseparator at Coronet Phosphate Plant Facilitates Recovery of Fines: Pit and Quarry, vol. 39, No. 3, September 1946, pp. 84–85, 92.

Tennessee phosphate rock sold or used by producers, 1942–46 [1]

Year	Long tons	Value at mines		Year	Long tons	Value at mines	
		Total	Average			Total	Average
1942	1,366,335	$6,127,792	$4.48	1945	1,294,297	$6,062,688	$4.68
1943	1,309,059	5,822,249	4.45	1946	1,362,600	7,014,490	5.15
1944	1,324,849	5,975,337	4.51				

[1] Includes small quantity of blue rock and also apatite from Virginia.

According to the annual report of the TVA for the fiscal year ended June 30, 1946, operations at the chemical plant at Muscle Shoals were directed again to the production of new and improved plant nutrients. More than 19,500 tons of elemental phosphorus were produced during the fiscal year ended June 30, 1946; and all but about 2,300 tons, shipped to the Chemical Warfare Service early in the year, was used for phosphatic fertilizers and animal-feed supplement. With acid-making facilities limiting output, production of phosphorus was about 66 percent of the 1945 figure. About 68,000 tons of triple superphosphate were produced, equaling 1939 production but below that in 1940 and 1941. Difficulty in procuring proper charges for the furnaces hampered production of calcium metaphosphate, but more than 8,100 tons were produced. Production of dicalcium phosphate continued. Byproducts of the electric furnace phosphorus production included 1,900 tons of potash-phosphate ash and 6,300 tons of ferrophosphorus. A small experimental plant was operated to produce a quantity of diammonium phosphate fertilizer. Experiments continued on a process for the production of high-grade red phosphorus, and design for a new type of acid plant to produce a superphosphoric acid (85 percent P_2O_5) was started. A new process for the agglomeration of phosphate fines for electric furnace charges was also developed during the 1946 fiscal year.

The newly constructed TVA fused tricalcium phosphate plant at Columbia, Tenn., expected initially to produce about 36,000 tons annually, was placed in production early in the fiscal year and more than 15,800 tons were produced.

During World War II TVA supplied more than 60 percent of the 98,000 tons of elemental phosphorus provided the armed forces for use in incendiary bombs, tracer bullets, smoke screens, and other combat uses. Over and above military demands, TVA supplied more than 375,000 tons of phosphate and nitrate fertilizer materials to help increase wartime food production in the United States and furnished 114,000 tons of fertilizers for lend-lease and other export to our allies. TVA also produced 17,000 tons of dicalcium phosphate to help meet the critical shortage of mineral feed supplements for livestock.

Large-scale mining by TVA in Tennessee was suspended during most of the first 6 months of 1946 to permit consumption of inventories of washed sands at Columbia, Tenn., and Wilson Dam, Ala.

Virginia.—Production of apatite continued in 1946 at the Piney River nelsonite deposit by the Calco Chemical Division of the American Cyanamid Co. Shipments of apatite for the manufacture of

superphosphate were made during the first half of the year. There were no shipments after June 1946.

This depost was described late in 1946 by Davidson, Grout, and Schwartz.[5] Their conclusions differ markedly from those of Ross,[6] as they consider that this deposit is in large part an irregular apatite-ilmenite-bearing dike intruded into an earlier closely related anorthosite and later sheared and hydrothermally altered.

WESTERN STATES

New high records both for quantity and value of marketed production high-lighted the Western States phosphate-rock industry in 1946. Marketed production jumped from 274,198 long tons in 1945 to 492,602 tons in 1946, an increase of 80 percent. A large part of this increase resulted from War Department purchases of phosphate rock for overseas shipments to occupied countries. The value nearly doubled, rising from $1,589,915 in 1945 to $3,012,157 in 1946. The output in 1946 came from Idaho, Montana, and Utah; Wyoming phosphate mines were inactive.

The average value per ton of the Western States phosphate rock sold or used, as reported by producers to the Bureau of Mines, increased again in 1946, rising from $5.80 per ton in 1945 to $6.11 per ton in 1946. Increases were recorded in both Idaho and Montana, with a 64-cent rise in the latter State.

Western States phosphate rock sold or used by producers, 1942–46

Year	Idaho [1]			Montana			Total		
	Long tons	Value at mines		Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average		Total	Average
1942	[1] 115,263	[1] $518,659	[1] $4.50	150,402	$572,464	$3.81	265,665	$1,091,123	$4.11
1943	108,916	561,630	5.16	119,764	488,665	4.08	228,680	1,050,295	4.59
1944	112,565	584,400	5.19	186,434	761,745	4.09	298,999	1,346,145	4.50
1945	123,340	673,627	5.46	150,858	916,288	6.07	274,198	1,589,915	5.80
1946	[1] 312,658	[1] 1,805,103	[1] 5.77	179,944	1,207,054	6.71	492,602	3,012,157	6.11

[1] Includes Utah as follows: 1942, 1,184 long tons ($7,410); and 1943–45, none. In 1946 Bureau of Mines not at liberty to show Utah separately.

In March 1946 the Geological Survey issued a compilation map,[7] on a scale of approximately 16 miles to the inch, showing the location of the trace of the outcrop of the phosphate-rock-bearing Permian Phosphoria formation in Montana, Idaho, Wyoming, and Utah. The map includes a list of the source data and a table showing the general thickness and grade of the phosphate rock deposits in certain areas.

[5] Davidson, D. M., Grout, F. F., and Schwartz, G. M., Notes on the Ilmenite Deposit at Piney River, Va.: Econ. Geol., vol. 41, No. 7, November 1946, pp. 738–748.

[6] Ross, Clarence S., Occurrence and Origin of the Titanium Deposits of Nelson and Amherst Counties, Va.: Geol. Survey Prof. Paper 198, 1941, 59 pp.

[7] Geological Survey, Permian Phosphate Deposits of Montana, Idaho, Wyoming, and Utah, as compiled from maps of the Geological Survey: Strategic Minerals Investigations Series, Preliminary Map 3-198 March 1946.

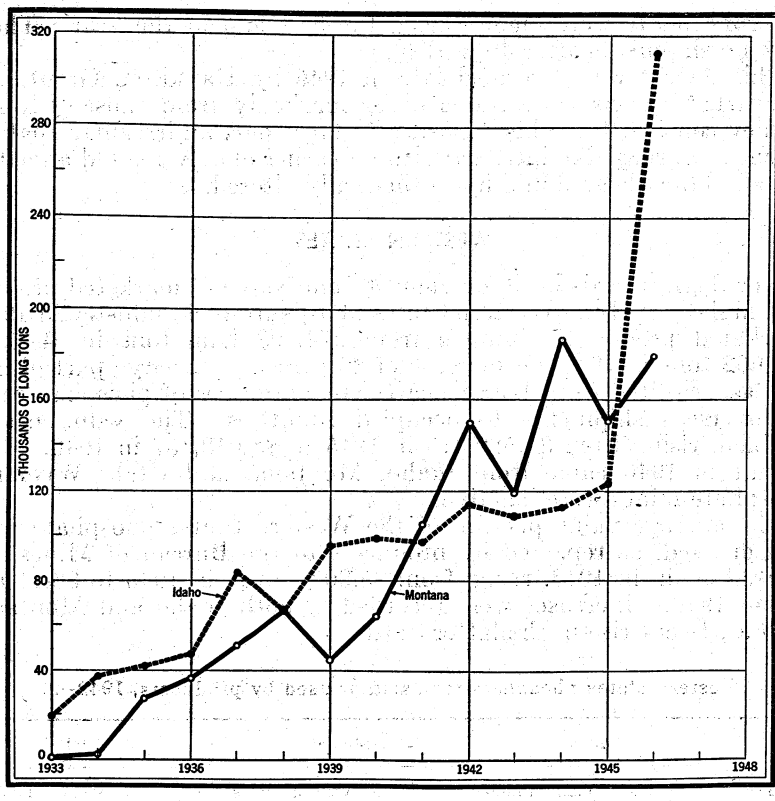

FIGURE 2.—Idaho and Montana phosphate rock sold or used by producers, 1933–46.

The production of fused phosphate rock-olivine and phosphate rock-serpentine fertilizers has begun on the west coast. The Permanente Metals Corp., Permanente, Calif., a Kaiser subsidiary, is said to have started commercial production late in 1946 at a rate of 150 tons a day of a phosphate fertilizer ("Thermo-Phos") by electric furnace fusion of serpentine, obtained locally, and Idaho phosphate rock. Two furnaces fomerly used to produce ferrosilicon were reconverted to manufacture the fertilizers. The product contains an appreciable amount of magnesium. Local demands are said to exceed Permanente's capacity. The fertilizer is reported suitable for direct application, but the major portion is used in mixed fertilizers. In Seattle, Manganese Products, Inc., is stated to have been ready, in the middle of 1946, to begin production of a fused fertilizer from phosphate rock and olivine (a magnesium-iron silicate) in an electric furnace. The phosphate rock is to come from the Philipsburg district, Montana, and the olivine from Cypress Island in the San Juan Archipelago in Puget Sound. The process has already been carried through the pilot-plant stage, according to reports, with a furnace of 4 tons daily capacity. The new commercial-scale plant is to have an output of 100 tons daily. The furnace is the direct-arc type, and is three-phase, three-electrode, nontilting, and topcharging.

The fertilizer contains over 20 percent available P_2O_5 (citric acid soluble) and 12 to 15 percent MgO. The finished product has an alkaline reaction.

Various chemical firms are reported to have recently investigated the economic possibilities of developing an elemental phosphorus industry in the intermountain area of the Western States, based on its immense phosphate-rock deposits and the availability of cheap power. The Bonneville Power Administration has released a preliminary appraisal of the markets, marketing area, possible production costs, and other factors affecting the soundness of an expanded production of phosphate fertilizer in the West.[8]

Idaho.—The output of phosphate rock in Idaho more than doubled the record tonnage produced in 1945, making that State the leading producer in the western region.

Only two companies in Idaho reported sales of phosphate rock in 1946. The larger producer, the San Francisco Chemical Co., 216 Pine Street, San Francisco 4, Calif., operated its Waterloo mine, near Montpelier, Bear Lake County, Idaho, selling the rock produced in both export and domestic markets but not consuming any of its production in its own California plant. The other company—the Anaconda Copper Mining Co.—operated its mine at Conda, Caribou County, Idaho. The shipments went, as in prior years, largely to the company plant at Anaconda, Mont., for conversion to superphosphate and phosphate chemicals. A considerable quantity was sold to other domestic consumers; none was exported. A new mine was opened by the J. R. Simplot Fertilizer Co. This company, which had operated the Government-financed fertilizer plant in Pocatello, Idaho, since its erection in 1944, announced its purchase in May 1946. This plant had been obtaining its phosphate rock from Caribou County, Idaho, and from near Montpelier, Bear Lake County, Idaho, and its sulfuric acid normally from Garfield, Utah. In June 1946, the J. R. Simplot Co. began phosphate-rock mining in Bingham County, Idaho, about 20 miles northeast of Pocatello on the Fort Hall Indian Reservation in T. 4 S., R. 37 E., Boise meridian. This mine is expected to develop into a source of 72-percent tricalcium phosphate rock much closer to the plant than the Montpelier and Conda mines. Diamond drilling is reported as being conducted by the company in other areas in the vicinity. The company in 1946 produced a large quantity of phosphate rock, which was hauled to the plant at Pocatello, where it was retained in stock, purchased material being used for its superphosphate operations. The superphosphate plant was being expanded in 1946, but its output is said to have been limited by strikes, particularly that at the Garfield sulfuric acid plant. The Teton Phosphate Co., Montpelier, Idaho, made no shipments in 1946 and did only development work at its mine near Montpelier during the year.

Montana.—Montana, the leading phosphate rock producer of the Western States for several years, dropped to second place in 1946; however, its marketed production—179,944 long tons—exceeded that

[8] Bonneville Power Administration, U. S. Department of the Interior, Preliminary Analysis of a Western Phosphate Fertilizer Industry: Paper presented by Roscoe E. Bell to the Fertilizer Committee of the National Grange, November 1946, and to the cooperative services conference of the American Farm Bureau Federation, December 1946.

of 1945—150,858 tons. Shipments were made by three companies. The Montana Phosphate Products Co., of Trail, British Columbia, the largest producer in Montana, operated its Anderson, Anaconda, and Gravely mines as well as several Government leases in the Garrison district. Most of the mined product was exported to the plant of the parent company, the Consolidated Mining & Smelting Co. of Canada, Ltd., at Trail, British Columbia. Only a small quantity was sold in the United States. Manganese Products, Inc., 4260 West Marginal Way, Seattle 6, Wash., shipped a small quantity of phosphate rock from a mine in the Philipsburg district, Montana. Lee H. Skeels, trustee and lessee of the Soluble Phosphates, Ltd., Maxville, Granite County, mined a small tonnage at a mine near Maxville and shipped the product for direct application to the soil. The Moonlight Mining Co., Maxville, operating a property near Princeton, is reported to have made a small shipment of phosphate rock in 1946. The International Minerals & Chemical Corp., confined its operations to mine and process development; it mined its property in the Douglas Creek area, Granite County, for about 2 months in 1946 but did not make any shipments during the year.

In November 1946 the Department of the Interior asked for bids for the development under lease of the phosphate-rock deposits in 200 acres in Silver Bow County. These deposits are in the Melrose phosphate-rock district in T. 2 S., R. 9 W., Montana principal meridian. The bids were opened on November 27, 1946, and the lease awarded to William Anderson, of Garrison, Mont. The lease—Great Falls 086,708 was issued January 10, 1947.

Utah.—Phosphate-rock operations in Utah in 1946 were confined to those of the Garfield Chemical & Manufacturing Corp., Salt Lake City, Utah, which mined and shipped phosphate rock from a Federal lease near Springville, Utah County, for use in iron-blast furnaces.

Wyoming.—No phosphate rock was produced in Wyoming in 1946. Although no mining operations were in progress on the John M. Thomas and the Walker-Doerr Phosphate Co. leases in the Sublette Ridge phosphate-rock field, southwestern Wyoming, development work was reported in the first half of the year.

FOREIGN TRADE[9]

Data on imports and exports of phosphate rock and other phosphatic materials are shown in the following tables.

[9] Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce. Export figures exclude Army shipments to occupied territories.

Phosphate rock and phosphatic fertilizers imported for consumption in the United States, 1942–46

Fertilizer	1942		1943		1944		1945		1946	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Apatite	179	$1,025	6,114	$81,890	6,090	$52,758	12,804	$102,435		
Phosphates, crude, not elsewhere specified	3,586	23,862	40,391	315,268	117,324	952,374	128,854	1,010,091	59,739	$601,683
Superphosphates (acid phosphates):										
Normal (standard), not over 25 percent P_2O_5 content	5,965	80,409	252	4,678	1,212	24,420	1,701	30,180	2,459	52,419
Concentrated (treble), over 25 percent P_2O_5 content	10,694	300,342	2,242	63,515	5	156	72	1,836	36	1,120
Ammoniated			60	3,698						
Total superphosphates	16,659	380,751	2,554	71,891	1,217	24,576	1,773	32,016	2,495	53,539
Ammonium phosphates, used as fertilizer	25,521	1,150,319	39,274	1,827,294	82,092	3,942,544	82,819	3,993,116	81,351	4,086,277
Bone dust, or animal carbon and bone ash, fit only for fertilizer	7,855	213,970	4,516	134,783	14,785	476,802	8,455	299,780	7,354	328,142
Guano	3,128	159,799	8,591	526,173	4,365	278,857	2,762	186,804	526	47,603
Slag, basic, ground or unground	1	10	3	56						
Precipitated bone, fertilizer grade	23	851	75	2,730					670	63,782

Phosphate rock exported from the United States, 1942–46, by countries and grades

State of origin and country of destination	1942		1943		1944		1945		1946	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Florida:										
High-grade hard rock:										
Australia					3,997	$21,983	23,174	$169,222	5,400	$45,900
Belgium and Luxembourg							21,000	175,750		
Canada	1,268	$8,951			1,470	8,958	572	4,332	263	1,893
Greece							3,500	23,625		
New Zealand									12,000	102,000
Sweden							18,700	158,950	81,782	707,523
United Kingdom	80,273	497,080	42,815	$272,547	17,914	121,400	4,500	29,250		
	81,541	506,031	42,815	272,547	23,381	152,341	71,446	561,129	99,445	857,316
Land pebble:										
Australia			24,457	128,628	27,011	163,983	46,526	272,139	45,800	382,705
British Guiana									5	69
Canada	97,951	909,986	129,913	1,522,182	166,050	1,926,142	133,690	1,518,649	144,183	1,553,518
Czechoslovakia							6,279	39,298		
Eire	6,697	46,879	18,204	137,336	5,447	47,280				
Greece							10,996	65,980		
Mexico							51	620	2,000	11,391
Netherlands							296	1,776	7,992	70,970
New Zealand			13,248	72,864	33,886	190,569	31,193	219,519	58,209	473,433
Poland and Danzig							2,997	17,964	3,492	24,444
Spain									12,554	111,895
Sweden							5,200	44,200		
Union of South Africa	3,299	18,969								
United Kingdom	183,178	906,316	26,614	141,122			24,118	112,677	57,605	429,676
Yugoslavia							12,136	72,811	2,201	15,407
	291,125	1,882,150	212,436	2,002,132	232,394	2,327,974	273,482	2,365,633	334,041	3,073,508
Other phosphate rock [1]	4	75	207	4,116	1,132	8,431	7,843	60,413	10,610	90,526
Total Florida	372,670	2,388,256	255,458	2,278,795	256,907	2,488,746	352,771	2,987,175	444,096	4,021,350
Tennessee, Idaho, and Montana rock:										
Canada	156,050	960,160	102,759	596,457	182,358	980,601	137,962	749,905	189,244	1,432,011
Grand total	528,720	3,348,416	358,217	2,875,252	439,265	3,469,347	490,733	3,737,080	633,340	5,453,361

[1] Includes sintered matrix.

Superphosphates (acid phosphates) exported from the United States, 1945–46, by countries

	1945		1946	
	Long tons	Value	Long tons	Value
Brazil	22,396	$467,137	21,244	$468,253
Canada	63,197	1,036,235	84,561	1,475,202
China			26,711	737,773
Colombia	4,449	88,954		
Czechoslovakia			4,668	232,510
El Salvador	562	14,861	879	28,630
Formosa			4,730	84,691
Greece	7,179	125,915	12,037	231,112
India and Dependencies	893	45,000	660	16,632
Netherlands	7,095	289,472	9,495	423,299
Poland and Danzig	9,464	180,450	34,530	926,957
United Kingdom	25,567	1,075,749	4,440	195,210
Venezuela	58	1,707	183	6,320
West Indies:				
British:				
Bahamas	45	960		
Leeward and Windward Islands	515	11,318	90	2,216
Trinidad and Tobago	172	5,376	1,169	38,100
Other British	50	2,470	224	9,524
Cuba	38,667	807,527	22,308	540,252
Haiti	1	127	2	275
Yugoslavia	3,186	47,456	6,613	174,740
Other countries	1,466	39,350	6,800	229,049
	184,962	4,240,064	241,344	5,820,745

Other phosphate materials [1] exported from the United States, 1942–46

Year	Long tons	Value	Year	Long tons	Value
1942	5,253	$292,859	1945	1,732	$140,363
1943	655	90,275	1946	1,018	144,478
1944	545	70,358			

[1] Class includes bone ash, dust, and meal; animal carbon for fertilizer; char dust; duplex basic phosphate; and South Carolina river rock.

TECHNOLOGIC DEVELOPMENTS

Various papers on developments in phosphate-rock technology that have been published in recent months are listed below.[10]

[10] Logue, Paul, Industrial Uses of Phosphates: Jour. Chem. Ed., vol. 23, No. 11, November 1946, p. 529. (Article reprinted from Food Materials and Equipment, April 1946.)

Hignett, T. P., and Hubbuch, T. N., Fused Tricalcium Phosphate: Ind. Eng. Chem., vol. 38, No. 12, December 1946, pp. 1208–1216.

Cass, W. G., Phosphating Metallic Surfaces, Part I, History and Pre-Treatment: Chem. Age, vol. 55, No. 1410, July 6, 1946, pp. 5–8; part II, Baths and Composition, Accelerating Methods: Chem. Age, vol. 55, No. 1411, July 13, 1946, pp. 35–38; part III, Finishing Treatment: Chem. Age, vol. 55, No. 1412, July 20, 1946, pp. 67–70; part IV, Antitrust and Patent Litigation in the U. S.: Chem. Age, vol. 55, No. 1413, July 27, 1946, pp. 101–104.

Hufferd, R. W., Spectacular Developments Made in Incendiaries: Chem. Eng., vol. 53, No. 10, October 1946, pp. 110–113.

Gibson, R. C., and Russell, W. S., Phosphate Coating of Aluminum: Ind. Eng. Chem., vol. 38, No. 12, December 1946, pp. 1222–1227.

Williams, D. E., MacLeod, F. L., Morrell, Elise, and Jones, F. P., Fused Tricalcium Phosphate Fertilizer Possible Animal Feed Supplement: Ind. Eng. Chem., vol. 38, 1946, pp. 651–4.

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WORLD PRODUCTION

The following table gives available figures on production of phosphate rock in various countries in recent years:

World production of phosphate rock, 1940–46, by countries, in metric tons [1]

[Compiled by B. B. Mitchell]

Country [1]	1940	1941	1942	1943	1944	1945	1946
Algeria	370,890	446,535	334,550	76,798	220,349	401,304	584,827
Australia:							
New South Wales	20	31	118	122			(2)
South Australia	254	8,597	14,182	12,976	4,167	725	20
Western Australia	39	21		43	2,251	8,619	(2)
Austria	(2)	(2)	(2)	(2)	(2)	(2)	3,240
Belgium	280	36,660	103,300	108,900	52,270	17,990	(2)
Brazil (apatite)	(2)	(2)	(2)	6,111	5,216	(2)	(2)
Canada	325	2,256	1,147	1,316	437	271	52
Chile (apatite)	32,000	29,123	24,909	37,924	50,840	13,203	(2)
Christmas Island, Straits Settlements (exports)	241,826	(2)	(2)	(2)	(2)	(2)	(2)
Egypt	183,464	111,708	328,440	315,566	318,185	349,374	(2)
Eire	(2)	(2)	16,444	17,252	20,300	(2)	(2)
France	24,260	98,660	113,400	131,020	92,966	60,622	88,924
French Oceania (exports)	164,170	192,235	176,065	188,385	203,300	259,000	(2)
Germany	1,548	1,043	829	(2)	(2)	(2)	(2)
India	119	81	337	1,215	232	532	(2)
Indochina, French:							
Phosphate rock	24,340	40,310	29,050	19,890	6,850		(2)
Apatite	2,070	30,800	98,800	64,600	300		(2)
Italy	274		(2)	(2)	(2)	(2)	(2)
Japan [3]	1,400	1,300	1,400	1,200	3,000	2,000	
Madagascar	495	(2)	(2)	(2)	(2)	(2)	(2)
Morocco, French	687,310	493,060	715,410	806,171	1,444,902	1,154,120	2,783,636
Nauru and Ocean Islands [4]	1,263,385	(2)	(2)	(2)	(2)	(2)	(2)
Netherlands Indies	34,085	(2)	[5] 24,000	[5] 24,000	[5] 24,000	(2)	(2)
Netherlands West Indies:							
Curaçao (exports)	6,047	111,995	(2)	(2)	7,813	8,770	(2)
New Zealand				9,389	20,251	8,084	11,224
Palestine	(2)	2	2,818	[6] 5,384	[6] 4,961	[6] 4,867	(2)
Rumania	95				(2)	(2)	(2)
Seychelles Islands (exports)	14,613	18,795	22,347	1,849	5,941	7,090	21,397
South-West Africa	869	(2)	59	164		27	1,665
Spain	15,781	13,846	15,232	15,722	17,770	20,349	18,608
Sweden (apatite)	7,479	31,116	79,395	144,265	160,847	(2)	(2)
Tanganyika Territory	9	33	25	269	28	(2)	279
Tunisia	1,187,823	1,076,118	879,743	334,678	522,265	706,404	1,399,880
Union of South Africa	(2)	425	9	5,801	21,088	(2)	(2)
U. S. S. R. (apatite)	[5] 2,600,000	[5] 2,000,000	(2)	(2)	(2)	(2)	(2)
United States (sold or used by producers)	4,066,943	4,764,921	4,718,780	5,208,508	5,462,938	5,899,921	6,970,827
Total [7]	10,933,000	9,510,000	7,701,000	7,540,000	8,674,000	8,924,000	11,885,000

[1] In addition to countries listed, Angaur Island, China, Formosa (Taiwan), New Caledonia, and Republic of the Philippines produce phosphate rock, but data of output are not available.
[2] Data not available.
[3] Preliminary data for Noto Peninsula, Honshu, for fiscal year ended March 31 of year following that stated.
[4] Exports during fiscal year ended June 30 of year stated.
[5] Estimate.
[6] Exports.
[7] Totals represent only those countries for which statistics are shown.

BASIC SLAG

Phosphatic slags obtained as byproducts of the smelting of high-phosphorus iron ores were very important sources of agricultural phosphates in Europe before the recent war, and some 5,200,000 tons of basic slag were produced there each year. The principal producers were Germany, France, Belgium, Luxembourg, United Kingdom, and Czechoslovakia. Germany alone produced about 2,500,000 tons a year and France 1,000,000 tons. Germany was the leading consumer—over 2½ million tons annually. Other important consumers were France, Netherlands, United Kingdom, Belgium, and Czechoslovakia. The European production of basic slag has been reduced to very low levels. In all western European countries, except the United Kingdom, its production has been greatly curtailed. Production figures for recent years are not available. Germany now is producing very little slag, and France during the year 1946–47 is expected to produce only 300,000 to 400,000 tons. In the United States the production of basic slag is very limited because of the low-phosphorus content of the iron ore currently used in this country, but no production figures for recent years are available. None has been imported into the United States since 1943.

Platinum and Allied Metals

By HUBERT W. DAVIS AND GERTRUDE N. GREENSPOON

GENERAL SUMMARY

SUSPENSION of ceiling prices on the six platinum-group metals by the Office of Price Administration on April 29, 1946, followed by greatly advanced quotations for platinum, ruthenium, and osmium, were features of the platinum industry in 1946. By mid-September the retail price of platinum and ruthenium had been raised $58 an ounce each, and osmium had been upped $50. Insufficient supplies, active demand, and speculation were largely responsible for the higher prices. Coincident with subsequent improvements in the supply and demand position, several price reductions were made on platinum and ruthenium, and by the year-end quotations on these metals had dropped to $56 an ounce.

Salient statistics of platinum and allied metals in the United States, 1945–46, in troy ounces

	1945	1946		1945	1946
Production:			Stocks in hands of refiners, importers, and dealers, Dec. 31:		
Crude platinum from placers	26,551	22,949	Platinum	138,839	187,624
New metals:			Palladium	119,757	132,523
Platinum	162,032	92,947	Other	43,376	41,876
Palladium	28,649	3,858		301,972	362,023
Other	13,825	4,973			
	204,506	101,778	Imports for consumption:		
Secondary metals:			Unrefined materials	172,029	76,012
Platinum	58,942	40,385	Refined metals	211,269	331,198
Palladium	32,968	27,856		383,298	407,210
Other	4,212	4,396	Exports:		
	96,122	72,637	Ore and concentrates		134
			Refined metals and alloys, including scrap	18,732	19,762
			Manufactures (except jewelry)	5,906	6,669

Platinum was refined in the United States in 1946 at a rate 40 percent lower than in 1945 and far below the domestic demand, which, however, was 30 percent smaller than in 1945. The refined-metal deficiency was met by imports of 119,853 ounces and by the release of 16,358 ounces by the Office of Metals Reserve. Much lessened demand and more abundant supplies of platinum in the fourth quarter of 1946 were reflected in a substantial increase in inventories of refiners and dealers. The jewelry trade was by far the largest outlet for platinum in 1946, taking 61 percent of the total sold. More platinum was sold to the jewelry trade in 1946 than in any previous year. The

record sales to the jewelry trade, however, were more than offset by drastic declines in demand by the chemical and electrical industries.

About half as much palladium was refined in the United States in 1946 as in 1945, comprising only one-seventh of sales, which established a new record. Quantity of palladium sold in 1946 was only 7 percent less than that of platinum. The deficit in palladium was met by importing 187,555 ounces of refined metal in 1946. The electrical industry again was the largest buyer of palladium and was responsible for most of the gain in total sales. However, demand by the jewelry trade, the second largest outlet, was slightly stronger than in 1945.

Much less of the other platinum metals—iridium, osmium, rhodium, and ruthenium—was refined than in 1945; this output was also substantially smaller than sales, which were greater for each metal except rhodium. The smaller recoveries by domestic refiners were supplemented by imports. Iridium and ruthenium were in much demand by the jewelry trade in 1946. Sales of rhodium were 26 percent less than in 1945.

Imports of platinum metals into the United States established a new high in 1946; they were 6 percent more than in 1945, the previous record year.

Figure 1 shows graphically the trend in world production of platinum metals from 1914 to 1946.

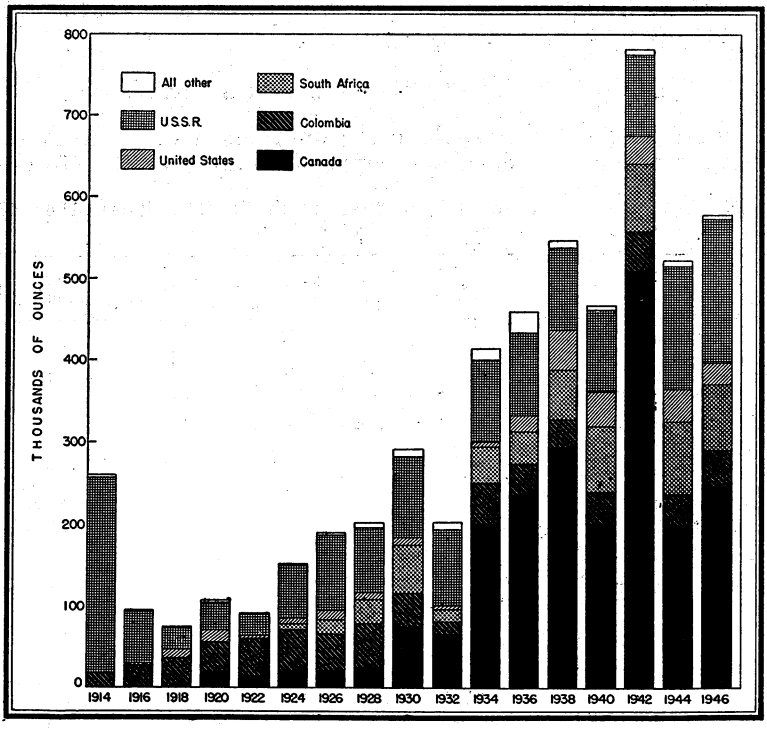

FIGURE 1.—Trend in world production of platinum metals, 1914–46.

CRUDE PLATINUM PRODUCTION

Mine returns for 1946 show a production of 22,882 ounces of crude platinum metals in Alaska and 67 ounces in California—a total of 22,949 ounces; comparable figures for 1945 are 26,505 ounces of crude platinum metals in Alaska, 43 ounces in California, and 3 ounces in Oregon—a total of 26,551 ounces. The Alaskan production, which contains about 90 percent platinum metals and a little gold, came from placer deposits in the Goodnews Bay district of southwestern Alaska. The operation of the Goodnews Bay Mining Co. in Alaska was described in the Mining World.[1] The output in California was a byproduct of gold placers in Butte, Sacramento, Shasta, Siskiyou, and Yuba Counties.

Many gold and copper ores in the United States contain small quantities of platinum metals. In 1946, 3,363 ounces of platinum metals were recovered as byproducts of refining gold and copper ores compared with 4,495 ounces in 1945.

Source of Purchases.—Purchases of domestic crude platinum metals by buyers in the United States were reported from the following sources in 1946: Alaska, 22,882 ounces, California, 215 ounces, and Oregon, 6 ounces—a total of 23,103 ounces (27,070 ounces in 1945). Domestic buyers also reported purchases of 42,813 ounces of foreign crude platinum metals from Colombia, 2 ounces from Canada, and 569 ounces of osmiridium from the Union of South Africa in 1946—a total of 43,384 ounces (29,571 ounces in 1945).

RECOVERY OF REFINED PLATINUM METALS

New Metals Recovered.—Reports from refiners of crude platinum metals, gold bullion, nickel, and copper indicate that 101,778 ounces

New platinum metals recovered by refiners in the United States, 1945–46, by sources, in troy ounces

	Platinum	Palladium	Iridium	Osmium	Rhodium	Ruthenium	Total
1945							
Domestic from—							
Crude platinum	22,923	126	4,453	845	632	118	29,097
Gold and copper refining	1,068	3,396	8	----------	20	3	4,495
	23,991	3,522	4,461	845	652	121	33,592
Foreign from—							
Crude platinum, Nickel and copper refining	138,041	25,127	1,322	----------	4,079	2,345	170,914
Total recovery	162,032	28,649	5,783	845	4,731	2,466	204,506
1946							
Domestic from—							
Crude platinum	23,107	166	2,437	447	626	91	26,874
Gold and copper refining	555	2,735	73	----------	----------	---------	3,363
	23,662	2,901	2,510	447	626	91	30,237
Foreign from—							
Crude platinum, Nickel and copper refining	69,285	957	485	28	770	16	71,541
Total recovery	92,947	3,858	2,995	475	1,396	107	101,778

[1] Mining World, Platinum Dredging: Vol. 8, No. 7, June 1946, pp. 26–29.

New platinum metals recovered by refiners in the United States, 1942–46, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1942	244,226	140,262	5,102	10,737	400,327
1943	234,320	82,441	5,286	13,209	335,256
1944	132,452	10,966	4,406	5,221	153,045
1945	162,032	28,649	5,783	8,042	204,506
1946	92,947	3,858	2,995	1,978	101,778

of platinum metals were recovered in the United States from such sources in 1946—a decrease of 50 percent from 1945. Of the new metals recovered in 1946, 70 percent was chiefly from concentrates from Canada and crude from Colombia, 27 percent from domestic crude (chiefly from Alaska) and 3 percent a byproduct of gold and copper ores.

Secondary Metals Recovered.—In 1946, 72,637 ounces of secondary platinum metals were recovered from the refining of scrap metal, sweeps, and other waste products of manufacture that contain platinum metals—a 24-percent decrease from 1945.

Substantial quantities of worn-out catalysts, spinnerets, laboratory ware, and other products are returned by consumers to refiners for refining. The refined platinum metals recovered from these products (or their equivalent in refined metals) are returned to the consumers. The platinum metals so recovered are not included in the statistics of secondary metals.

Secondary platinum metals recovered in the United States, 1942–46, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1942	56,150	16,416	1,552	2,493	76,611
1943	68,613	23,616	2,771	6,581	101,581
1944	85,942	29,684	965	2,805	119,396
1945	58,942	32,968	812	3,400	96,122
1946	40,385	27,856	2,002	2,394	72,637

PRICES

Buyers reported purchases at $35 to $78.85 an ounce for domestic and foreign crude platinum metals and osmiridium in 1946. This price range results chiefly from variations in iridium content of crudes and from market fluctuations for refined platinum metals in 1946.

Maximum prices for the six platinum metals, fixed by the OPA on February 1, 1943, remained in effect until April 29, 1946, when they were suspended. The maximum prices per troy ounce for refined metals of a commercial purity of at least 99.5 percent were as follows: Platinum, $35; palladium, $24; iridium, $165; osmium, $50; rhodium, $125; and ruthenium, $35.

Suspension of the ceiling prices on the platinum-group metals was followed by greatly advanced quotations for platinum, ruthenium, and osmium. By September 16 the retail price of platinum and ruthenium had risen to a peak of $93 an ounce, and osmium had been raised to $100. Iridium, usually more sensitive to supply and demand rumors and to speculation than any of the other platinum metals, was advanced on June 27 from $95–$100 an ounce to $125, which however, was $40 less than the OPA fixed price. Insufficient supplies,

active demand, and speculation were largely responsible for the higher prices. Coincident with improvements in the supply and demand position, several price reductions were made on platinum and ruthenium, and by the year end they had been lowered to $56 an ounce. Iridium remained at $125 an ounce until October 24; thereafter it fluctuated between $130 and $110. Quotations on palladium and rhodium remained stable at $24 and $125 an ounce, respectively, throughout 1946.

CONSUMPTION

As pure metals, combined, clad, or alloyed with other metals, the platinum metals are employed in the electrical and chemical industries, in dentistry and jewelry, and for numerous miscellaneous purposes. Uses of the platinum metals are tabulated on page 801 of the Platinum and Allied Metals chapter in Minerals Yearbook, 1943. Sales of platinum metals to consumers in the United States were 484,575 ounces in 1946 compared with 550,045 ounces in 1945, an all-time high. In 1946, for the first time, sales of palladium, which established a new record, almost equaled those of platinum.

Platinum continued to be the most widely used metal of the group, but in 1946 sales were only 8 percent greater than those of palladium. Sales of platinum constituted 234,479 ounces (48 percent) of the total platinum metals sold to domestic consumers in 1946. By taking 61 percent of the total platinum sold in 1946, the jewelry industry was the chief buyer, displacing the chemical industry, which ranked first in 1945 but dropped to third place in 1946. Sales of platinum (144,015 ounces) to the jewelry trade were 77 percent greater than in 1945 and were larger than in any previous year. The record sales of platinum to the jewelry trade, however, were more than offset by drastic declines in demand by the chemical and electrical industries. Sales of platinum to these industries were only 31,107 and 35,007 ounces, respectively, or declines of 73 and 67 percent from 1945. Sales of platinum for dental and medical uses also dropped substantially (29 percent) from 1945 and comprised only 21,859 ounces (9 percent) of the total sold.

Sales of palladium established a new high in 1946 and for the first time almost equaled those of platinum. Palladium constituted 217,181 ounces (45 percent) of the total platinum metals sold to consumers in the United States in 1946. The electrical industry retained first place as a buyer of palladium in 1946 by taking 91,243 ounces (42 percent) of the total palladium sold. Sales of palladium to the electrical industry established a new record in 1946 and were 32 percent greater than in 1945. Despite the swing from palladium to platinum for fine jewelry upon removal of the restriction on the use of platinum, sales of palladium have continued at a high level and established a new peak in 1946. Sales of palladium to the jewelry trade were 60,294 ounces in 1946, an increase of 7 percent over 1945. The dental and medical trades continued to be the third largest outlet for palladium, but sales were 2 percent less in 1946 than in 1945. The dental and medical trades took 41,407 ounces (19 percent) of the total palladium sold in 1946. Sales of palladium to the chemical industry, which also reached a new peak, were 68 percent more than in 1945; however, they were only 15,092 ounces (7 percent) of the total sold in 1946. Appreciable quantities of palladium were sold to the pen and pencil trade for nibs and other parts in 1946.

Sales of the other platinum metals—iridium, osmium, rhodium, and ruthenium—were comparatively small; they made up 7 percent (32,915 ounces) of the total for the group in 1946. Iridium and ruthenium, hardening additions for platinum and palladium, were in much demand by the jewelry trade and, consequently, were the metals of this group most extensively sold, followed in order by rhodium and osmium. Sales of iridium, ruthenium, and osmium were 41, 10, and 69 percent, respectively, larger than in 1945, but sales of rhodium were 26 percent smaller.

The accompanying table shows reported sales of platinum metals to consuming industries in the United States for 1927–46. The figures for 1939 and earlier years do not include the sales of some

Platinum metals sold to consuming industries in the United States, 1927–46, in troy ounces

Year	Chemical			Electrical			Dental and medical		
	Platinum	Palladium	Other platinum-group metals	Platinum	Palladium	Other platinum-group metals	Platinum	Palladium	Other platinum-group metals
1927	11,010	180	276	14,905	2,491	1,739	7,504	12,194	153
1928	18,529	1,252	248	21,316	9,150	1,527	10,930	12,270	177
1929	20,260	1,345	346	20,746	18,856	1,103	13,051	12,156	1,024
1930	15,022	854	83	8,529	9,569	934	11,810	15,436	117
1931	11,483	979	82	8,215	22,628	626	10,135	9,394	87
1932	5,157	495	270	3,456	6,309	454	8,683	12,900	82
1933	14,085	338	255	3,422	5,367	556	11,149	15,946	135
1934	14,699	285	142	3,587	4,468	603	6,776	19,555	80
1935	13,404	69	103	5,867	5,490	938	9,694	20,916	173
1936	20,984	124	387	8,750	13,297	1,261	15,489	25,481	174
1937	18,300	170	329	9,465	20,854	1,328	11,115	40,214	136
1938	14,328	402	302	5,645	10,447	847	12,324	18,833	182
1939	20,306	468	813	11,952	21,510	1,346	13,755	22,989	139
1940	31,174	1,624	3,286	17,548	32,528	5,100	9,859	26,346	228
1941	68,285	3,342	4,154	28,368	35,456	5,214	19,426	31,440	270
1942	94,025	5,480	5,668	92,961	28,452	12,446	13,077	27,480	106
1943	131,716	14,162	4,154	185,281	25,907	15,851	27,044	41,522	160
1944	60,936	9,673	3,944	178,038	42,322	11,650	34,783	36,377	177
1945	115,816	8,988	6,182	107,260	69,300	5,572	30,871	42,259	900
1946	31,107	15,092	4,219	35,007	91,243	3,513	21,859	41,407	145

Year	Jewelry and decorative			Miscellaneous and undistributed			Total			
	Platinum	Palladium	Other platinum-group metals	Platinum	Palladium	Other platinum-group metals	Platinum	Palladium	Other platinum-group metals	All platinum-group metals
1927	86,036	3,706	4,388	3,176	312	1,616	122,631	18,883	8,172	149,686
1928	93,468	4,965	4,075	5,431	2,136	1,813	149,674	29,773	7,840	187,287
1929	84,039	4,451	4,588	7,234	1,048	1,372	145,330	37,856	8,433	191,619
1930	44,801	2,807	2,933	3,324	1,621	1,084	83,486	30,287	5,151	118,924
1931	41,261	2,988	2,449	5,896	1,934	1,040	76,990	37,923	4,284	119,197
1932	33,376	5,817	2,033	3,896	204	301	54,568	25,725	3,140	83,433
1933	41,263	4,413	4,116	6,274	100	402	76,193	26,164	5,464	107,821
1934	32,959	6,015	2,626	3,113	506	490	61,134	30,829	3,941	95,904
1935	56,182	5,095	4,087	2,505	200	341	87,652	31,770	5,642	125,064
1936	50,936	5,778	4,166	16,288	859	873	112,447	45,539	6,861	164,847
1937	49,848	8,277	3,696	7,223	55	1,120	95,951	69,570	6,609	172,130
1938	44,654	5,356	2,674	10,617	35	660	87,568	35,073	4,665	127,306
1939	47,385	5,899	3,446	6,868	540	941	100,266	51,406	6,685	158,357
1940	51,296	7,624	4,759	13,101	1,197	1,220	122,978	69,319	14,593	206,890
1941	66,151	7,999	6,228	7,845	667	3,552	190,075	78,904	19,418	288,397
1942	66,518	19,658	4,275	2,595	390	2,681	269,176	81,460	25,176	375,812
1943	438	45,218	2,080	240	10,900	4,559	344,719	137,709	26,804	509,232
1944	424	56,558	2,847	1,467	9,409	3,599	275,648	154,339	22,217	452,204
1945	81,305	56,578	10,026	1,599	8,107	5,282	336,851	185,232	27,962	550,045
1946	144,015	60,294	17,039	2,491	9,145	7,999	234,479	217,181	32,915	484,575

imported metals and are not, therefore, exactly comparable with those for later years, which comprise sales by refiners, importers, dealers, and Office of Metals Reserve.

STOCKS

Stocks of platinum metals in all forms in the hands of refiners, importers, and dealers totaled 362,023 ounces on December 31, 1946, compared with 301,972 ounces at the close of 1945. In addition, the Office of Metals Reserve held 78,137 ounces of refined platinum on December 31, 1946.

Stocks of platinum metals held by refiners, importers, and dealers in the United States, Dec. 31, 1942–46, in troy ounces

Year	Platinum	Palladium	Iridium, osmium, rhodium, and ruthenium	Total
1942	160,724	107,383	35,280	303,387
1943	176,560	104,372	42,081	323,013
1944	159,173	123,448	39,866	322,487
1945	138,839	119,757	43,376	301,972
1946	187,624	132,523	41,876	362,023

FOREIGN TRADE [2]

Platinum metals (unmanufactured) imported for consumption in the United States, 1945–46

Material	1945		1946	
	Troy ounces	Value	Troy ounces	Value
Unrefined materials: [1]				
Ores and concentrates of platinum metals	138,089	$3,955,645	28,639	$843,538
Grains and nuggets (including crude, dust, and residues)	31,875	1,041,684	[2] 38,735	[2] 1,913,066
Sponge [3] and scrap	2,008	63,903	[2] 7,962	[2] 524,005
Osmiridium	57	4,261	676	31,233
Total	172,029	5,065,493	76,012	3,311,842
Refined metals:				
Platinum [3]	72,849	2,688,613	119,853	6,273,058
Palladium	118,270	2,597,815	187,555	3,421,815
Iridium	6,197	504,666	12,402	1,096,762
Osmium	925	43,669	1,969	177,030
Rhodium	3,975	452,873	525	52,816
Ruthenium	9,053	296,804	8,894	362,997
Total	211,269	6,584,440	331,198	11,384,478
Grand total	383,298	11,649,933	407,210	14,696,320

[1] The concentrates and crude imported from Canada contain platinum, palladium, iridium, rhodium, and ruthenium, and the crude sponge imported from Canada contains platinum and palladium. Although the U. S. Department of Commerce records "platinum content" for these entries, the Bureau of Mines has determined from the importers of these materials that most of the entries reflect the platinum metals content. The Bureau of Mines has also determined from the largest importer of crude platinum from Colombia that the entries for his material, recorded as "platinum content" by the U. S. Department of Commerce, represent the gross weight of the material.

[2] Bureau of Mines has determined that 7,000 ounces (valued at $490,000) classified as "grains and nuggets" by the U. S. Department of Commerce was crude sponge and is, therefore, included with "sponge and scrap" in this table.

[3] Commercially pure platinum sponge is classified by the Bureau of Mines as refined metal and, is therefore, included with refined platinum in this table.

[2] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Imports.—Imports of platinum metals into the United States established a new high in 1946; they were 6 percent more than in 1945, the previous record year. The principal sources of imported platinum metals in 1946 were Canada (216,762 ounces), U. S. S. R. (106,851 ounces), United Kingdom (40,199 ounces), and Colombia (38,658 ounces). Imports of refined metals (331,198 ounces) were 57 percent more than in 1945, but imports of unrefined material (76,012 ounces) were 56 percent less. Imports of refined platinum, palladium, iridium, and osmium were 65, 59, 100, and 113 percent, respectively, greater than in 1945, but imports of rhodium and ruthenium were 87 and 2 percent, respectively, less.

Platinum metals (unmanufactured) imported for consumption in the United States, 1945–46, by countries, in troy ounces

Country	Unrefined materials [1]				Refined metals					
	Ores and concentrates of platinum metals	Grains and nuggets (including crude, dust, and residues)	Sponge [2] and scrap	Osmiridium	Platinum [2]	Palladium	Iridium	Osmium	Rhodium and ruthenium	Total
1945										
Australia				29			45			74
Canada	138,089	89	1,997		6,098	107,551	3,932		8,778	266,534
Colombia		31,786								31,786
U. S. S. R.					66,748	9,966	1,027			77,741
United Kingdom				28		753	1,193	925	4,250	7,149
Other countries			11		3					14
Total	138,089	31,875	2,008	57	72,849	118,270	6,197	925	13,028	383,298
1946										
Australia					209					209
Canada	24,630	[3] 9	[3] 7,674		53,778	122,001	1,870		6,800	216,762
Colombia	2,025	36,618			15					38,658
Ecuador		1,465			191					1,656
Egypt					322					322
Ethiopia	1,929									1,929
Union of South Africa	43			438						481
U. S. S. R.					40,168	60,581	4,721	1,286	95	106,851
United Kingdom		643	169	238	25,158	4,973	5,811	683	2,524	40,199
Other countries	12		119		12					143
Total	28,639	[3] 38,735	[3] 7,962	676	119,853	187,555	12,402	1,969	9,419	407,210

[1] See footnote 1 of preceding table.
[2] Commercially pure platinum sponge is classified by the Bureau of Mines as refined metal and is, therefore, included with refined platinum in this table.
[3] Bureau of Mines has determined that 7,000 ounces classified as "grains and nuggets" by the U. S. Department of Commerce was crude sponge and is, therefore, included with "sponge and scrap" in this table.

Platinum metals imported for consumption in the United States, 1942–46 [1]

Year	Troy ounces	Value	Year	Troy ounces	Value
1942	315,002	$11,306,565	1945	383,298	$11,649,933
1943	362,251	10,936,243	1946	407,210	14,696,320
1944	356,212	10,675,303			

[1] See footnote 1 of preceding table.

Exports.—Exports of refined platinum (including scrap) increased to 15,468 ounces in 1946 (7,781 ounces in 1945), but those of the other platinum-group metals (including scrap) decreased to 4,294

ounces (10,951 ounces in 1945). The chief foreign markets for platinum were Brazil (6,512 ounces), Mexico (1,849 ounces), United Kingdom (1,846 ounces), France (1,519 ounces), and Argentina (1,108 ounces) and for the other platinum-group metals Canada (1,341 ounces), Brazil (724 ounces) and Switzerland (585 ounces).

Platinum and allied metals exported from the United States, 1944–46, by countries

Country	Platinum (bars, ingots, sheets, wire, sponge, and other forms, including scrap)		Palladium, rhodium, iridium, osmiridium, ruthenium, and osmium (metal and alloys, including scrap)		Manufacturers of, except jewelry	
	Troy ounces	Value	Troy ounces	Value	Troy ounces	Value
1944						
Argentina	30	$1,080	197	$7,156	3	$280
Brazil	509	20,653	740	22,083	190	11,185
Canada	468	21,903	3,460	343,000	1,736	69,647
Chile	81	3,533	1	42	10	982
China	38	1,350			126	3,289
Colombia	3	120	141	3,763	2	332
Cuba	22	585	111	2,983	5	381
Mexico	2	73	170	4,766	55	2,257
Uruguay	16	628	160	4,136	(1)	23
Venezuela	25	888	25	619	31	782
Other countries	49	1,201	9	382	229	10,198
Total	1,243	52,014	5,014	388,930	2,387	99,356
1945						
Argentina			8	588	8	463
Australia	523	20,440				
Brazil	3,909	116,083	509	13,051	185	7,093
Canada	488	13,705	8,996	745,524	2,555	32,129
Chile	172	9,887	16	384	24	1,295
China	2	26	16	417	25	473
Colombia	1	59	160	3,989	53	1,265
Cuba	385	13,709	165	4,389	54	2,053
Czechoslovakia	192	1,686			131	2,074
Mexico	271	10,300	453	12,818	163	7,338
Netherlands	33	288			155	778
Poland and Danzig	57	3,987			331	2,123
Switzerland	1	60	225	11,189	1	33
U. S. S. R.	48	9,284	48	326		
United Kingdom	960	59,505			1,404	90,689
Uruguay	101	3,856	204	5,510		
Venezuela	49	1,855	51	1,196	2	655
Yugoslavia	139	6,478			454	3,321
Other countries	450	17,745	100	3,462	361	8,688
Total	7,781	288,953	10,951	802,843	5,906	160,470
1946						
Argentina	1,108	73,891	63	2,261	78	13,305
Belgium and Luxembourg	436	29,239	19	1,700	380	29,306
Brazil	6,512	402,159	724	21,060	414	14,991
Canada	177	11,381	1,341	68,435	3,640	142,146
Chile	422	24,984	3	95	58	3,245
China			26	1,192	35	1,135
Colombia	215	13,651	54	1,470	48	2,104
Cuba	592	35,123	209	5,588	13	562
Czechoslovakia	25	221			41	194
France	1,519	77,116	277	6,233	994	25,530
Mexico	1,849	133,613	287	11,917	460	8,559
Netherlands	32	2,374	32	2,490		
Peru	19	1,597	12	100	31	940
Poland and Danzig					51	194
Sweden	200	7,135	2	354	98	4,668
Switzerland			585	21,232	35	390
Turkey					66	2,798
United Kingdom	1,846	116,628	400	44,000	19	600
Uruguay	261	19,201			2	79
Venezuela	5	202	10	2,407	15	803
Other countries	250	16,891	250	6,274	191	4,833
Total	15,468	965,406	4,294	196,808	6,669	256,382

[1] Less than 1 ounce.

Platinum and allied metals exported from the United States, 1942–46

Year	Ore and concentrates		Platinum (bars, ingots, sheets, wire, sponge, and other forms including scrap)		Palladium, rhodium, iridium, osmiridium, ruthenium, and osmium (metal and alloys, including scrap)		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value	Troy ounces	Value	Troy ounces	Value
1942	159	$6,581	3,354	$126,007	99,107	$2,301,953	1,246	$61,088
1943	84	3,642	860	43,961	521	28,264	1,802	70,226
1944	------	------	1,243	52,014	5,014	388,930	2,387	99,356
1945	------	------	7,781	288,953	10,951	802,843	5,906	160,470
1946	134	10,377	15,468	965,406	4,294	196,808	6,669	256,382

WORLD REVIEW

World production of platinum and allied metals, 1939–46, in troy ounces

[Compiled by B. B. Mitchell]

Country and product	1939	1940	1941	1942	1943	1944	1945	1946
Australia:								
New South Wales: Placer platinum	7	12	23	2	3	2	2	(1)
Tasmania: Placer osmiridium	283	465	207	142	90	107	109	95
Belgian Congo: From refineries:								
Palladium	3,344	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Platinum	1,157	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Canada:								
Placer platinum	25	24	60	30	219,713	157,523	[3]208,234	130,400
From refineries: [2] Platinum	148,877	108,464	124,257	285,198				
Other platinum metals	135,402	91,522	97,432	222,573	126,004	42,929	[3]458,674	114,200
Colombia: Placer platinum (exports)	39,070	35,859	37,349	49,163	39,961	36,136	35,129	43,835
Ethiopia: Placer platinum	6,000	6,000	1,000	1,000	1,000	942	(1)	(1)
Italy: From refineries: Platinum	1,608	965	(1)	(1)	(1)	(1)	(1)	(1)
Japan: Placer platinum	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Netherlands Indies (probably placer platinum)	28	34	(1)	(1)	(1)	(1)	(1)	(1)
New Zealand: Placer platinum	13	------	35	21	5	------	------	14
Panama: Placer platinum	------	------	(1)	(1)	(1)	(1)	(1)	(1)
Papua: [4]								
Placer platinum	2	(1)	5	(1)	(1)	(1)	(1)	(1)
Placer osmiridium	4	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Sierra Leone: Placer platinum	83	135	21	(1)	(1)	(1)	(1)	(1)
Union of South Africa:								
Platinum (content of platinum metals) [5]	18,068	20,140	73,348	73,797	73,745	22,509	22,400	23,300
Concentrates (content of platinum metals) [6]	41,243	51,835				58,070	53,500	51,800
Osmiridium [6]	7,031	6,379	7,141	7,770	5,993	6,142	(1)	(1)
U. S. S. R.: Placer platinum (estimate)	100,000	100,000	100,000	100,000	125,000	150,000	150,000	175,000
United States:								
Placer platinum	32,460	33,800	26,221	23,213	27,162	33,625	26,551	22,949
Ore (content of platinum metals)	66	------	15	26	------	------	------	------
From refineries: [7]								
Platinum	5,270	4,470	1,805	4,333	5,205	3,286	1,068	555
Other platinum metals	3,364	3,304	4,689	5,472	5,185	3,638	3,427	2,808
Total (estimate)	543,000	465,000	479,000	778,000	634,000	520,000	[3]971,000	576,000

[1] Data not available.
[2] Recovered from nickel-copper mattes. The figures for 1945–46 represent the platinum metals contained in the concentrates actually recovered, whereas those for 1939–44 represent the metals refined from Canadian concentrates at Acton, England, plus the platinum metals content of concentrates sold.
[3] Includes certain adjustments to account for metals produced in Canada in 1938–44 but not previously accounted for in the statistics.
[4] Year ended June 30 of year stated.
[5] Produced from platinum ores.
[6] Produced from treatment of gold ores on the Witwatersrand and Extensions.
[7] New platinum metals recovered in gold and copper refining of domestic materials.

Canada.—According to the Dominion Bureau of Statistics, production of platinum metals from the nickel-copper ores of the Sudbury district, plus a very small quantity from placers in British Columbia, was 130,400 ounces of platinum and 114,200 ounces of other platinum-group metals in 1946, compared with 208,234 ounces of platinum and 458,674 ounces of other platinum-group metals in 1945. The figures on production for 1945 and 1946 represent the platinum metals contained in the concentrates actually recovered, whereas those for many previous years represent the metals refined from Canadian concentrates at Acton, England, plus the platinum-metals content of concentrates sold. Moreover, the figures for 1945 include certain adjustments to account for metals produced in 1938–44 but not previously included in the statistics.

Sales of platinum metals by the International Nickel Co. of Canada, Ltd., were 320,794 ounces in 1946 compared with 381,741 ounces in 1945.

Colombia.—The South American Gold & Platinum Co. produced 30,797 ounces of crude platinum metals in 1946 (20,346 in 1945). The crude material contains about 85 percent platinum metals. The production of crude platinum metals by other operators was about 13,742 ounces in 1946 (14,411 in 1945).

Union of South Africa.—According to the Department of Mines, 73,495 ounces of crude platinum containing 22,509 ounces of platinum metals and 1,326 short tons of concentrates containing 58,070 ounces of platinum metals were produced in South Africa in 1944, the latest year for which detailed information is available. Thus, total output of platinum metals was 80,579 ounces in 1944; sales were 71,465 ounces. The average composition of the product sold in 1944 was: Platinum, 63.58 percent; palladium, 27.01 percent; iridium, 0.38 percent; osmium and osmiridium, 0.03 percent; rhodium, 1.12 percent; ruthenium, 4.39 percent; and gold, 3.49 percent.

Outputs of crude platinum and concentrates were 75,906 ounces and 1,183 short tons, respectively, in 1946 compared with 73,166 ounces and 1,122 tons, respectively, in 1945. No assay data are available for 1945 and 1946; in 1944 the crude platinum averaged 30.63 percent platinum metals, and the concentrates contained 43.79 ounces of platinum metals per ton. The crude platinum and concentrates are produced in the Rustenburg district.

Output of osmiridium, which is recovered in the treatment of gold ores on the Witwatersrand and Extensions, was 6,142 ounces in 1944, and sales were 6,896 ounces. The average composition of the product sold in 1944 was: Osmium, 29.18 percent; iridium, 26.34 percent; ruthenium, 12.88 percent; platinum, 11.52 percent; rhodium, 0.68 percent; gold, 2.39 percent; and undetermined, 17.01 percent.

Potash

By BERTRAND L. JOHNSON AND DOROTHY I. MARSH

GENERAL SUMMARY

MORE new records were made in 1946 in the potash industry of the United States, both production of marketable potassium salts and sales reaching new highs. Production in 1946 was 1,687,735 short tons of potassium salts containing 931,812 tons of equivalent potash (K_2O), an increase over 1945 of 99,430 tons of potassium salts and 57,569 tons of K_2O. The production of marketable potassium salts in the United States has increased each year since 1934. (See fig. 1.) Sales (1,673,249 tons) were 76,089 tons greater in 1946 than in 1945 and contained 928,374 tons of K_2O. Stocks of potassium salts in producers' hands at the end of 1946 were larger than in 1945, as was also the K_2O content. Exports of fertilizer potash materials continued to decline, whereas those for chemical uses were considerably larger. Imports of potash materials for fertilizer purposes increased in 1946, but those of chemical materials decreased. Domestic consumption of potash again made a new high record—actual sales for consumption reaching 862,532 tons, according to the American Potash Institute.

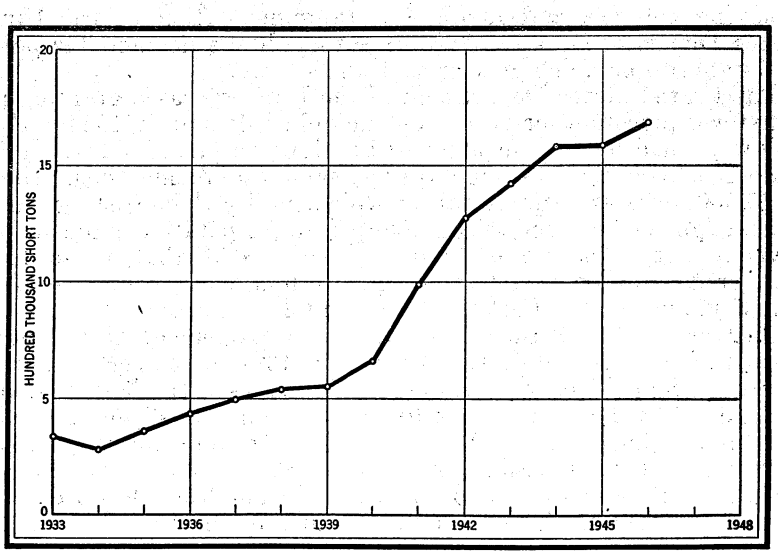

FIGURE 1.—Production of marketable potash salts in the United States, 1933-46.

Salient statistics of the potash industry in the United States, 1944–46

	1944	1945	1946
Production:			
Potassium salts (marketable)—short tons	1,578,498	1,588,305	1,687,735
Approximate equivalent, K_2O—do	834,568	874,243	931,812
Sales by producers:			
Potassium salts—do	1,543,420	1,597,160	1,673,249
Approximate equivalent, K_2O—do	817,892	870,370	928,374
Value at plant	$29,487,413	$30,313,919	$32,175,716
Average per ton	$19.11	$18.98	$19.23
Imports:			
Fertilizer materials—short tons	13,739	6,885	7,872
Approximate equivalent, K_2O—do	3,760	3,871	2,564
Value	$397,575	$230,714	$249,819
Chemical materials—short tons	5,402	10,327	8,327
Approximate equivalent, K_2O—do	1,108	2,152	1,801
Value	$1,650,776	$3,079,761	$2,100,915
Exports:			
Fertilizer materials—short tons	110,057	104,687	96,822
Approximate equivalent, K_2O[1]—do	61,312	58,310	53,930
Value	$3,139,631	$2,986,990	$2,983,751
Chemical materials—short tons	15,444	18,966	23,905
Approximate equivalent, K_2O[1]—do	7,568	9,273	11,713
Value	$3,142,096	$3,648,795	$5,055,441
Consumption:			
Apparent consumption:[2]			
Potassium salts—short tons	1,437,060	1,490,719	1,569,225
Approximate equivalent, K_2O—do	753,880	808,809	867,197

[1] Estimate by Bureau of Mines.
[2] Quantity sold by producers, plus imports, minus exports.

Government allocation of potash, under Schedule 98 of General Chemicals Order M–300, was suspended September 30, 1945. It was resumed, however, under Schedule 120 of General Chemicals Order M–300, on June 1, 1946. This latter schedule, in turn, was revoked by the Civilian Production Administration on February 17, 1947.[1] This step, according to CPA, complied with the general policy of removing controls and followed a recommendation of the United States Department of Agriculture, although the demand for potash was stated to be much greater than the supply.

The United States Department of the Interior ceased granting permits for exploration for potash on the public domain in 1934. Hearings were held by the Department at Albuquerque, N. Mex., in September 1946 on the question of the advisability of raising the maximum of 15,360 acres (24 square miles) which, under then-existing regulations, might be held under lease and permit for potash exploration and development. The potash industry contended that those limits hampered exploratory activities, might threaten continuance of the industry, and might affect the future supply of potash.

On March 24, 1947, the Bureau of Land Management, United States Department of the Interior, in Circular 1643, released certain amendments to the existing regulations which increased the land that may be held under Federal permit to prospect for potash on the public domain to 25,600 acres (40 square miles); at the same time, 15,360 acres may be held under lease, making a total of 40,960 acres. Heretofore the total permissible area under permits and leases has been limited to 15,360 acres. The Government, in these new regulations, lim-

[1] Federal Register ,February 18, 1947 ,p. 1106.

ited its right to purchase potash produced under the lease to one-tenth of the production, instead of the one-fourth previously stipulated.[2]

An important discovery of thick beds of potash overlying salt beds in the Unity oilfield, about 100 miles northwest of Saskatoon, in the southern part of the Province of Saskatchewan, Canada, was reported to have been made in June 1946 at a depth of 3,466 feet in a deep-test drilling for oil and gas. The deposits are said to extend southeastward about 350 miles, from the Unity field to Radville, Saskatchewan, thence into North Dakota, and possibly farther southward. The beds of potash salts encountered range from 9 to 28 feet in thickness. They are said to contain as high as 65.6 percent potassium chloride and the K_2O content to average 21.5 percent. Additional drilling to determine the extent of the deposit is reported in progress in the Verbata area, Saskatchewan.

Turrentine,[3] Albright,[4] and Kinnard[5] have discussed general features of the potash industry in 1946.

PRODUCTION AND SALES

Both production and sales of domestic marketable potassium salts were considerably larger in 1946 than in 1945, continuing the upward trend in evidence since 1934. The increases in 1946 over 1945 were larger than those shown in the latter year over 1944, both in marketed production and sales. Production of potassium salts in 1946 totaled 1,687,735 short tons, with an equivalent K_2O content of 931,812 tons. Sales were 1,673,249 tons, with an equivalent K_2O content of 928,374 tons. Production of potassium salts exceeded sales, and stocks in producers' hands at the end of the year showed an increase over those on December 31, 1945. The value of the sales in 1946 exceeded 32 million dollars. The average value per ton of the potassium salts sold in 1946 was $19.23, slightly higher than that of 1945.

Production of both grades of muriate of potash and of sulfate of potash and sulfate of potash-magnesia were larger in 1946 than in 1945. Production of manure salts (98,333 tons), however, even with the inclusion of spillage of higher-grade salts, continued in 1946 the decline that began in 1944 and now is much less than half of the 1943 production of 242,189 short tons. (See fig. 2.)

The Western States production remains the dominant factor in the domestic potash industry. California, New Mexico, and Utah furnished virtually all of the 1946 output, the larger part coming from the deeply buried Permian saline sedimentary deposits of sylvite and langbeinite of the Carlsbad region, southeastern New Mexico. The Eastern States supplied only a small quantity—from well brines in Michigan and as a byproduct of cement operations in Maryland.

Stocks in producers' hands at the end of the year have been rising steadily since 1942, reaching 37,999 short tons K_2O in 1946. (See fig. 3.)

[2] U. S. Department of the Interior, Information Service, Bureau of Land Management, New Potash Regulations Approved: April 3, 1947.
[3] Turrentine, J. W., Potash Aplenty: Fertilizer Review, vol. 22, No. 2, March-April 1947, pp. 3–6, 11.
[4] Albright, H. M., Potash: Min. Cong. Jour., vol. 33, No. 2, February 1947, pp. 102–104.
[5] Kinnard, Virginia, Potash Production in 1946 Will Establish New Highs: Domestic Commerce, vol. 34, No. 12, December 1946, pp. 43–46.

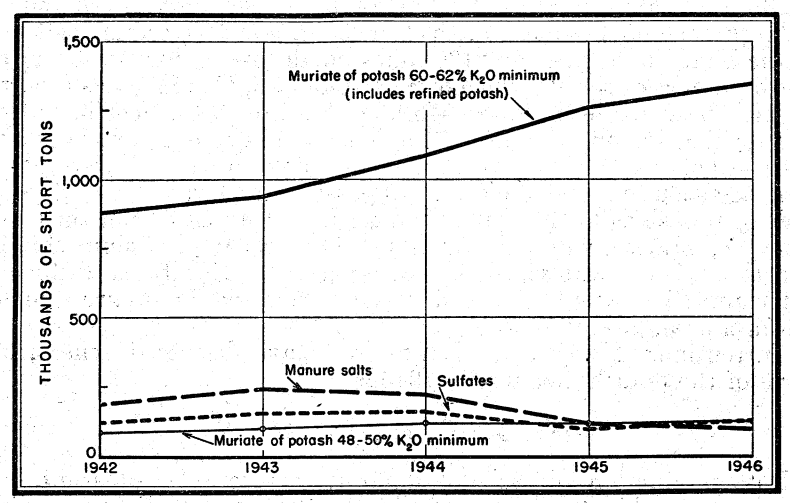

FIGURE 2.—Potassium salts produced in the United States, 1942-46, by grades, in short tons.

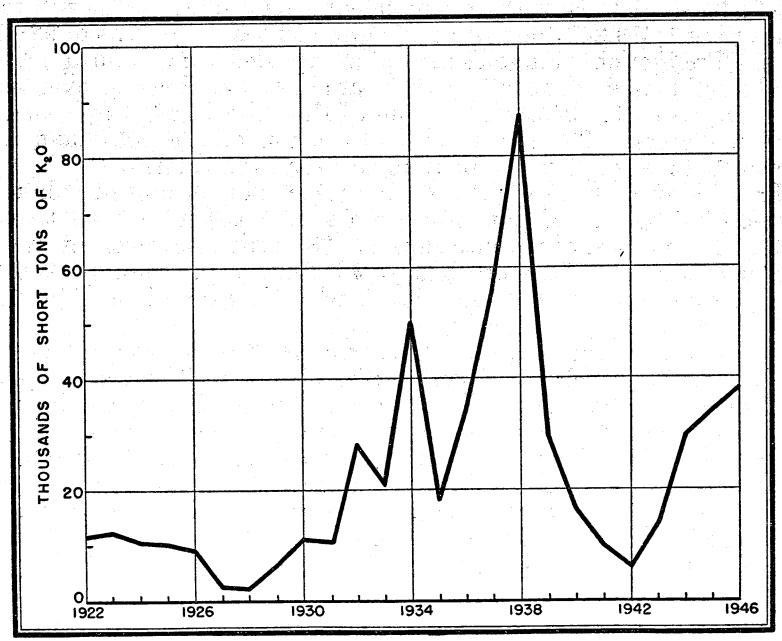

FIGURE 3.—Equivalent potash (K_2O) content in producers' stocks at end of year, 1922-46, in short tons.

Potassium salts produced in the United States, 1944–46, by grades, in short tons

Grade	1944	1945	1946
Muriate of potash:			
60–62 percent K_2O minimum [1]	1,082,132	1,258,332	[2] 1,346,699
48–50 percent K_2O minimum	114,550	117,677	122,257
Manure salts	217,560	115,798	[3] 98,333
Sulfate of potash and sulfate of potash-magnesia	164,256	96,498	120,446
	1,578,498	1,588,305	1,687,735

[1] Includes refined potash.
[2] Includes some 93–96 percent KCl.
[3] Includes spillage of some higher-grade salts.

The potash-producing companies in the United States in 1946, by States, were as follows:

California:

American Potash & Chemical Corp., 122 East Forty-second Street, New York, N. Y. (plant at Trona, on Searles Lake, Calif.).

Maryland:

North American Cement Corp., 41 East Forty-second Street, New York, N. Y. (plant at Security, Md.).

Michigan:

Dow Chemical Co., Midland, Mich. (brine wells and plant near Midland, Mich.).

New Mexico:

International Minerals & Chemical Corp., 20 North Wacker Drive, Chicago, Ill. (mine and plant near Carlsbad, N. Mex.).

Potash Co. of America, Carlsbad, N. Mex. (mine and plant near Carlsbad, N. Mex.).

United States Potash Co., Inc., 30 Rockfeller Plaza, New York, N. Y. (mine and plant near Carlsbad, N. Mex.).

Utah:

Bonneville, Ltd., 540 West Seventh South, Salt Lake City, Utah (plant near Wendover, Utah).

Max Krotki, Marysvale, Utah (alunite open-cut operations at Marysvale, Utah).

Production and sales of marketable potassium salts and stocks in the hands of producers for the last 5 years are summarized in the accompanying table.

Potassium salts produced, sold, and in producers' stocks in the United States, 1942–46

Year	Production			Sales				Producers' stocks, Dec. 31		
	Operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)	Operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)	Value f. o. b. plant	Operators	Potassium salts (short tons)	Equivalent as potash (K_2O) (short tons)
1942	7	1,267,455	679,206	7	1,277,317	680,831	$22,962,518	7	14,158	6,041
1943	7	1,428,840	739,141	7	1,401,271	732,151	26,183,073	7	43,591	13,984
1944	6	1,578,498	834,568	6	1,543,420	817,892	29,487,413	6	76,123	29,763
1945	7	1,588,305	874,243	6	1,597,160	870,370	30,313,919	7	68,796	34,253
1946	7	1,687,735	931,812	7	1,673,249	928,374	32,175,716	7	82,554	37,999

CONSUMPTION

Apparent consumption of potash salts in the United States and its possessions increased from 808,809 short tons of potash (K_2O) in 1945 to 867,197 tons in 1946, as determined by subtracting exports from the sum of the imports and producers' sales.

Sales of potash in the United States for consumption and export, 1944–46, in short tons of K_2O

	1944	1945	1946
Deliveries of primary potash of domestic origin by major companies, as from reports of American Potash Institute—			
In United States and possessions:			
Agricultural	675,787	724,900	790,928
Chemical	82,198	85,169	75,797
For export	57,850	58,117	56,402
	815,835	868,186	923,127
Imports for consumption plus sales of minor domestic producers	5,364	6,435	5,048
	821,199	874,621	928,175
Total exports (estimate by Bureau of Mines)	68,880	67,583	65,643
Actual sales for consumption in the United States	752,319	807,038	862,532

The accompanying table, based largely upon deliveries of potash of domestic origin as reported by the American Potash Institute, indicates actual sales of 862,532 tons for domestic consumption in the

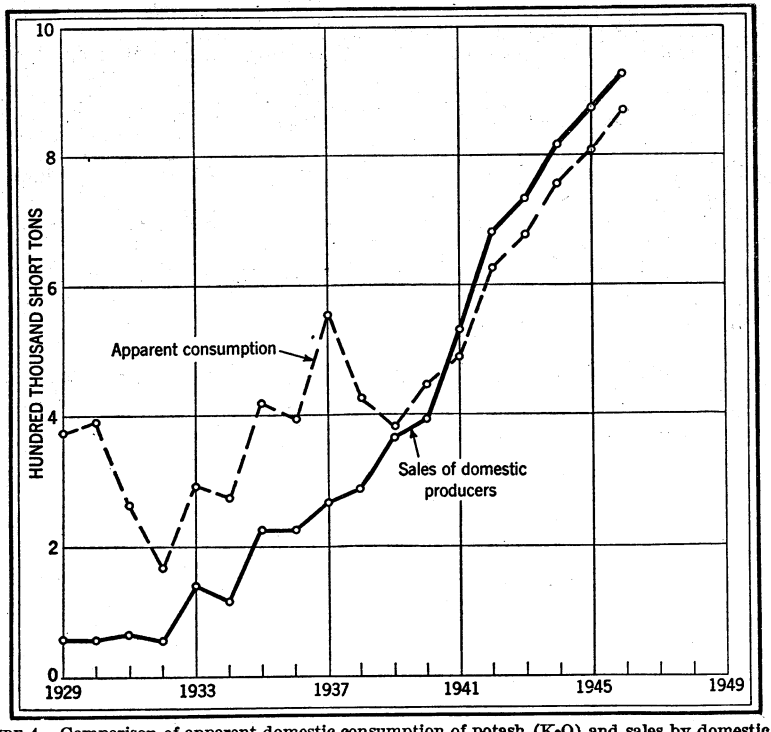

FIGURE 4.—Comparison of apparent domestic consumption of potash (K_2O) and sales by domestic producers of potash in the United States, 1929–46.

United States in 1946, an increase of 55,494 tons over the consumption in 1945.

Apparent domestic consumption of potash salts, in terms of equivalent potash (K_2O), and its relationships to sales of domestic producers, as reported to the Bureau of Mines for a period of years, are shown in figure 4.

According to the American Potash Institute, 763,590 short tons of agricultural potash (K_2O) of American origin and 75,797 tons of chemical potash (K_2O) were delivered in the United States in 1946, a total of 839,387 short tons.

Deliveries of agricultural potash and chemical potash in the calendar year 1946 are shown by States of destination in the accompanying tables. Georgia retained its leading position for deliveries of agricultural potash, and Illinois moved into second from fifth place. New York remains by far the leading recipient of chemical potash.

Deliveries of agricultural potash salts of American origin, by States of destination, in 1946, in short tons of K_2O

[American Potash Institute]

Georgia	70,709	Kentucky	8,661
Illinois	64,222	Texas	5,886
Ohio	63,574	Connecticut	5,033
Florida	62,389	Minnesota	4,201
Virginia	58,998	Delaware	3,851
North Carolina	55,441	Washington	3,132
Maryland	45,704	Missouri	2,985
South Carolina	43,715	Iowa	2,691
Indiana	39,615	Oregon	1,802
New Jersey	32,564	Colorado	505
Alabama	28,319	North Dakota	410
Tennessee	23,538	Vermont	284
Louisiana	16,984	Idaho	277
Pennsylvania	16,544	West Virginia	167
New York	15,259	District of Columbia	142
Maine	14,074	Arizona	70
Massachusetts	13,825	Utah	45
Mississippi	13,315	Montana	27
California	12,607	Kansas	24
Michigan	12,430	New Hampshire	24
Wisconsin	9,943	Rhode Island	24
Arkansas	9,572	New Mexico	8

Deliveries of chemical potash salts of American origin, by States of destination, in 1946, in short tons of K_2O

[American Potash Institute]

New York	53,939	Michigan	385
West Virginia	3,468	Kansas	361
California	3,420	Oklahoma	334
Ohio	2,680	Connecticut	200
Nevada	2,413	Tennessee	186
New Jersey	1,799	Georgia	152
Texas	1,684	Missouri	110
Maryland	1,214	Iowa	90
Pennsylvania	880	Kentucky	31
Oregon	631	Colorado	25
Illinois	622	Massachusetts	25
Virginia	564	Florida	23
Delaware	561		

PRICES

Prices of potash—muriate of potash, manure salts, sulfate of potash, and sulfate of potash-magnesia—were covered during most of 1946 by Revised Maximum Price Regulation 205 (Fertilizer Raw Materials) of June 30, 1944. Amendment 10 to RMPR 205, issued May 27, 1946, and effective June 1, 1946,[6] increased the maximum price that could be charged for domestic sulfate of potash (basis 90 percent K_2SO_4) in bulk, for spot sales at west coast potash ports, to $39.25 per ton.

These price controls on potash were abolished on November 10, 1946, when all commodities except sugar and rice were exempted from price control by Office of Price Administration Supplementary Order 193, dated November 12, 1946.[7]

The regular price schedules for the 1946–47 season were announced in June and July 1946 by the major producers, on the same basis as the previous year. These prices, as reported by various companies on a basis bulk ex-vessel port, except for manure salts (the basis for which is f. o. b. seller's plant, Carlsbad, N. Mex.), were as follows:

Muriate of potash (62 to 63 percent K_2O; 62 percent minimum) Muriate of potash (60 percent K_2O minimum) Muriate of potash, granular (48 percent K_2O minimum)	53½ cents per unit K_2O.
Manure salts (22 percent K_2O minimum)	20 cents per unit K_2O.
Sulfate of potash (90 to 95 percent K_2SO_4, basis 90 percent K_2SO_4)	$36.25 per short ton.
Sulfate of potash-magnesia (basis 40 percent K_2SO_4, 18.50 percent MgO)	$26.00 per short ton.

REVIEW BY STATES

Five States—California, Maryland, Michigan, New Mexico, and Utah—produced merchantable potash salts in 1946. The output of the individual States cannot be given (except for New Mexico, where three companies were operating) without disclosing individual company returns. New Mexico was by far the largest domestic producer, contributing 84 percent of the total. California, a much smaller producer than New Mexico, furnished much more than the combined output of the other three States. Michigan is a new producer.

California.—The American Potash & Chemical Corp., New York, N. Y., remains the only potash-producing company on the Pacific coast. Potash is recovered from brines saturating the crystalline salt mass of Searles Lake in southeastern California, and potassium chloride and potassium sulfate are produced and marketed. A description of the deposit has recently been published.[8]

On March 27, 1946, 478,194 shares of the American Potash & Chemical Corp., which had been seized by the Alien Property Custodian as enemy property, were sold to a group of investment bankers—Kuhn, Loeb, & Co., Glore, Forgan & Co., and Lehman Bros.[9] These shares were offered for sale by the bankers on March 29, 1946,[10] and

[6] Federal Register, May 28, 1946, p. 5782.
[7] Federal Register, November 14, 1946, p. 13464.
[8] Mining World, Searles Lake Geology: Vol. 8, No. 5, April 1946, pp. 15–17, 29.
[9] Chemical Engineering, Shares of American Potash Sold with Restrictions: Vol. 53, No. 4, April 1946, p. 155.
[10] Standard Corporation Records, Corporation News Edition, June 1946: Vol. 24, No. 110, sec. 4, June 10, 1946, p. 4711.

100,000 of the shares were purchased by the Heyden Chemical Corp.,[11] making it the principal stockholder.[12] The remainder of the shares are said to have been widely distributed through sale to the public.[13]

Maryland.—The North American Cement Corp., New York City, was the only company in Maryland producing potash in 1946. This company recovered byproduct potash from cement-kiln flue dust at its plant at Security, Washington County, near Hagerstown. The product, an impure sulfate of potash of low potash content, was sold for agricultural use. This was the only operation of its kind reported in the United States in 1946.

Michigan.—Potassium chloride was produced in 1946 from natural brine from wells at Midland, Mich., by the Dow Chemical Co.

New Mexico.—Mine production of potash salts in the Carlsbad region of New Mexico continued to increase, and again a new record was made. The three companies operating in this area mined 4,309,649 short tons of sylvinite and crude langbeinite combined in 1946—an increase of 359,666 tons over 1945. The K_2O content of the mine production in 1946 was 893,126 short tons. The average equivalent K_2O content of the mined salts decreased slightly—from 21.34 percent in 1945 to 20.72 percent in 1946.

All three companies mined sylvite (potassium chloride) and one—International Minerals & Chemical Corp.—also mined langbeinite (potassium-magnesium sulfate). The greater part of the mine production of the region was sylvite, most of which was processed to yield 60 percent or higher-grade muriate. The production of merchantable potash salts in New Mexico in 1946 was 1,428,860 short tons, with an equivalent K_2O content of 782,166 tons. Sales were 789,473 tons, valued at $27,187,228. Muriate of potash was produced by all three companies. Potassium sulfate and potassium-magnesium sulfate (sulfate of potash-magnesia) were produced by the International Minerals & Chemical Corp. from langbeinite in the refinery at its mine near Carlsbad. Potassium sulfate was also produced by the Potash Co. of America.

Several articles and a large illustrated booklet have been published recently describing the potash operations of the Carlsbad region.[14]

Utah.—Commercial production of potash in Utah in 1946 was restricted to the potassium-bearing brines of Salduro Marsh and to the alunite deposits of the Marysvale district.

Bonneville, Ltd., continued to produce potassium chloride from the Salduro Marsh brines at its plant near Wendover, Tooele County, northwestern Utah, its output in 1946 being much larger than in 1945.

[11] Standard Corporation Records, Corporation News Edition, October-November 1946: Vol. 24, No. 209, sec. 4, October 29, 1946, p. 3473.
[12] Oil, Paint & Drug Reporter, Heyden Chemical Largest Holder in American Potash: Vol. 149, No. 17, April 29, 1946, p. 3.
[13] Chemical and Metallurgical Engineering, Eastern Firm Buys Stock of American Potash: Vol. 53, No. 5, May 1946, p. 202.
[14] Harley, G. T., and Weaver, G. C., Prospecting for Potash in the Permian Basin Area, near Carlsbad, N. Mex.: Am. Inst. Min. and Met. Eng. Tech. Pub. 2056, 1946, 6 pp.
Harley, G. T., and Atwood, G. E., Langbeinite—Mining and Processing: Ind. Eng. Chem., vol. 39, No. 1, January 1947, pp. 43-47.
Harley, G. T., Mechanization of Operations in Potash Mining: Min. Cong. Jour., vol. 32, No. 11, November 1946, pp. 24-28, 61.
Storms, W. R., Diamond Drilling of Potash Reserves in Eddy County, N. Mex.: Bureau of Mines Rept. of Investigations 3861, 1946, 11 pp.
Potash Company of America, The Salt of the Earth: Carlsbad, N. Mex., 1946, 23 pp.
Barr, J. A., Machines for Nonmetallic Flotation: Am. Inst. Min. and Met. Eng. Tech. Pub. 1922, Min. Technol., vol. 9, No. 5, 1945, 11 pp.
Ware, Louis, Magnesium from Potash Ores: Trans. Am. Inst. Min. and Met. Eng., vol. 159, 1944, pp. 280-284.

A description of the deposit and the method of mining and treatment of the potash brines was published in 1946.[15]

The only alunite production reported in the Marysvale district in 1946 came from the White Hills claim of Max Krotki, where a small quantity of crude alunite was obtained in open-cut operations, and shipped.

Operations by Kalunite, Inc., at the White Horse mine have been permanently discontinued and the mine lease canceled. The Government-financed experimental plant operated by this company in Salt Lake City, Utah, was idle in 1946. During the early part of the year it was held in stand-by status and was not on the market for sale or lease. On July 10, 1946, it was declared surplus. It was advertised for sale by the War Assets Administration on January 2, 1947, with a cut-off date early in February, which was later extended to March 20, 1947. Bids have since been received for the plant and in April 1947 were up before the Board of Review for consideration. This plant, the property of the Defense Plant Corporation, is reported to have cost $4,905,000. It was still in the preliminary stages of operation when it was closed down. The designed annual capacity is said to have been 72,000,000 pounds of alumina, with potassium salts to be recovered as coproducts. It is situated on a site of 79 acres on a Denver & Rio Grande Western Railroad siding from the Roper, Utah, yards. A description of the plant is contained in a brochure of the Defense Plant Corporation.

Several articles have been published recently relative to the occurrence of alunite in the Marysvale district.[16]

No development work is known to have been done in 1946 in the Grand County potash field in eastern Utah.

FOREIGN TRADE[17]

Imports.—Imports of potash salts continued at low levels in 1946, the total of 16,199 tons (4,365 tons K_2O) being below that of 1945. The total value of the imports likewise decreased, from $3,310,475 in 1945 to $2,350,734 in 1946, this decline being due largely to decreased importations of argols. France, Chile, and the U. S. S. R. were the principal sources of imports in the order given.

Potash (K_2O) for fertilizer use constituted only 59 percent of the imports for 1946, whereas in 1945 fertilizers had formed 64 percent of the total. Imports for chemical use in 1946 rose to 41 percent of the total compared with 36 percent in 1945.

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[15] Denver Equipment Co., Beneficiation of Bonneville Potash Deposits: Deco Trefoil, vol. 10, No. 3, March 1946, pp. 5–12.

[16] Willard, M. E., and Proctor, P. D., White Horse Alunite Deposit, Marysvale, Utah: Econ. Geol., vol. 41, No. 6, September–October 1946, pp. 619–643.
Hild, J. H., Exploration of Alunite Deposits, Marysvale, Piute County, Utah: Bureau of Mines Rept. of Investigations 3972, 1946, 74 pp.
Willard, M. E., Kelley, V. C., and Callaghan, Eugene, The Winkelman Alunite Deposit, Marysvale, Utah: Geol. Survey, 1945, Prelim. Maps, plates 1 and 2, Strategic Minerals Investigation Series, and 2 pages of text (mim.).

[17] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

The principal potash salt imported for fertilizer use was crude potassium-sodium nitrate from Chile. A slightly smaller quantity of potassium chloride came from the U. S. S. R. Imports of potassium-bearing materials for consumption in the chemical industries consisted largely of argols from numerous countries, but principally from France, Italy, and Portugal. Several hundred tons of chlorate and perchlorate of potash also came in, largely from France.

Potash materials imported for consumption in the United States, 1945–46

Material	Approximate equivalent as potash (K_2O) (percent)	1945				1946			
		Short tons	Approximate equivalent as potash (K_2O)		Value	Short tons	Approximate equivalent as potash (K_2O)		Value
			Short tons	Percent of total			Short tons	Percent of total	
Used chiefly in fertilizers:									
Muriate (chloride)	56.4	6,861	3,870	64.3	$230,371	3,452	1,947	44.6	$103,217
Potassium-sodium nitrate mixtures, crude	14.0	-------	-------	-------	----------	4,400	616	14.1	146,312
Other potash fertilizer material [1]	6.0	24	1	.0	343	20	1	.0	290
Total fertilizer	-------	6,885	3,871	64.3	230,714	7,872	2,564	58.7	249,819
Used chiefly in chemical industries:									
Bicarbonate	46.0	-------	-------	35.7	----------	50	23	41.3	8,313
Bitartrate:									
Argols	20.0	9,805	1,961		2,873,916	7,617	1,523		1,935,796
Cream of tartar	25.0	98	25		77,910	60	15		44,113
Bromide	39.6	-------	-------		----------	(2)	(2)		42
Carbonate	61.0	-------	-------		----------	2	1		2,104
Caustic	80.0	20	16		8,248	45	36		17,684
Chlorate and perchlorate	36.0	374	135		93,197	525	189		69,353
Iodide	28.0	-------	-------		----------	(2)	(2)		5
Nitrate	46.0	-------	-------		----------	(2)	(2)		364
All other	50.0	30	15		26,490	28	14		23,141
Total chemical	-------	10,327	2,152	35.7	3,079,761	8,327	1,801	41.3	2,100,915
Grand total	-------	17,212	6,023	100.0	3,310,475	16,199	4,365	100.0	2,350,734

[1] Chiefly wood ashes from Canada.
[2] Less than 1 ton.

Potash materials imported for consumption in the United States, 1945–46, by countries, in short tons

[Figures in parentheses in column headings indicate, in percent, approximate equivalent as potash (K_2O)]

Country	Bicarbonate (46)	Muriate (chloride) (56.4)	Bitartrate: Argols or wine lees (20)	Bitartrate: Cream of tartar (25)	Potassium sodium nitrate mixtures, crude (14)	Chlorate and perchlorate (36)	All other [1]	Total: Short tons	Total: Value
1945									
Algeria			1,885					1,885	$458,816
Argentina			1,265					1,265	507,578
Canada		[2]	1			334	24	359	87,341
Chile			81					81	31,400
France			2,848					2,848	968,704
Italy			552					552	182,685
Mexico			5					5	3,025
Morocco, French			1,083					1,083	78,292
Portugal			1,194	43				1,237	364,914
Spain			717	55				772	304,794
Sweden						40	20	60	14,960
Tunisia			174					174	51,115
U. S. S. R.		6,861						6,861	230,361
United Kingdom							30	30	26,490
		6,861	9,805	98		374	74	17,212	3,310,475
1946									
Argentina			382					382	167,308
Australia							7	7	1,108
Belgium and Luxembourg						17		17	3,482
Canada			1	[3]			23	24	2,319
Chile			247		4,400	40		4,687	241,143
China		[2]					2	2	2,496
Czechoslovakia	50							50	8,313
France			4,662			343		5,005	1,271,170
Hong Kong							[2]	[2]	64
Italy			1,373	1				1,374	205,607
Morocco, French			57					57	7,800
Portugal			763	29				792	234,352
Spain				30				30	22,716
Sweden						28	38	66	21,105
Switzerland			22			97		119	19,601
Tunisia			110					110	17,500
U. S. S. R.		3,452						3,452	102,831
United Kingdom							25	25	21,819
	50	3,452	7,617	60	4,400	525	95	16,199	2,350,734

[1] Approximate equivalent as potash (K_2O)—1945–46: 45 percent.
[2] Less than 1 ton.

Exports.—The total value of the export trade in potash materials increased in 1946 to $8,039,192 from $6,635,785 in 1945, a slight decline being shown in the value of the fertilizer potash materials exported and a marked increase registered in the value of chemical potash. The total quantity of fertilizer potash materials in 1946—96,822 short tons—was considerably less than in 1945, and the value remained slightly below $3,000,000. The fertilizer exports went largely to Canada, with much smaller quantities to several other countries, mostly in the Western Hemisphere. Exports of chemical potash materials increased from 18,966 tons in 1945 to 23,905 short tons in 1946, valued at $5,055,441. Canada, China, and Mexico, in the order named, were the leading recipients.

Potash materials exported from the United States, 1942–46

Year	Fertilizer		Chemical		Year	Fertilizer		Chemical	
	Short tons	Value	Short tons	Value		Short tons	Value	Short tons	Value
1942	84,402	$2,184,044	13,307	$3,611,656	1945	104,687	$2,986,990	18,966	$3,648,795
1943	111,541	3,168,446	20,133	3,950,542	1946	96,822	2,983,751	23,905	5,055,441
1944	110,057	3,139,631	15,444	3,142,096					

Potash materials exported from the United States, 1945–46, by countries

Country	Fertilizers				Chemicals			
	1945		1946		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Algeria			1	$90	190	$62,045	229	$57,843
Argentina	(1)	$98	(1)	122	318	57,103	1,255	242,495
Australia	(1)	80			700	103,188	1,146	164,658
Barbados	3,149	108,099	318	11,028	(1)	58	(1)	66
Belgian Congo					37	9,218	7	1,554
Belgium and Luxembourg			1	65			893	181,236
Brazil	3,524	150,784	5,311	236,206	1,735	339,106	1,915	356,064
Canada	82,302	2,219,583	77,616	2,263,041	3,052	493,934	3,848	604,265
Chile	(1)	1			168	51,595	160	40,527
China							2,759	711,625
Colombia	966	33,369	350	11,610	328	92,714	619	143,055
Costa Rica	(1)	18	55	2,359	32	12,250	51	17,898
Cuba	7,681	255,059	5,173	176,522	188	70,052	280	89,950
Egypt					212	46,993	86	21,867
Hong Kong							1,216	316,393
Iceland	277	10,216	504	19,476	53	12,156	79	14,017
India and Dependencies					268	102,562	392	115,197
Iran					87	34,663	28	10,539
Mexico	927	21,996	1,106	34,317	1,143	281,409	2,199	477,310
Morocco, French	(1)	3			222	32,424	80	13,927
Netherlands							456	107,694
New Zealand	3,568	99,525	3,640	115,279	55	8,845	3	794
Sweden			(1)	371	1,137	237,285	1,265	229,478
Switzerland					1,026	181,428	1,121	189,480
Union of South Africa	104	4,263	(1)	141	374	85,023	355	82,185
U. S. S. R.					1,500	278,449	1	1,214
United Kingdom					2,067	299,783	50	33,715
Uruguay					67	20,418	112	26,540
Venezuela	60	2,699	135	6,214	123	30,881	239	90,062
Other countries	2,129	81,197	2,612	106,910	3,884	705,213	3,061	713,793
	104,687	2,986,990	96,822	2,983,751	18,966	3,648,795	23,905	5,055,441

[1] Less than 1 ton.

WORLD PRODUCTION

The accompanying table shows available statistics of potash output in the various producing countries.

World production of potassium salts and equivalent K_2O, 1941–46, by countries, in metric tons [1]

[Compiled by B. B. Mitchell]

Country [1]	1941		1942		1943	
	Potassium salts	Equivalent K_2O	Potassium salts	Equivalent K_2O	Potassium salts	Equivalent K_2O
North America: United States, potassium salts	894,895	476,156	1,149,810	616,162	1,296,215	670,534
South America: Chile, crude potassium nitrate	(2)	(2)	63,828	(2)	63,828	(2)
Europe:						
France (Alsace), crude potassium salts	4,235,426	673,000	3,835,395	619,000	4,195,111	[3] 713,200
Germany, crude potassium salts:						
Carnallite [4]	17,223,917	2,171,358	16,802,179	2,078,785	16,976,952	2,086,639
Kainite, sylvinite, and hartsalz						
Spain, crude potassium salts	[5] 314,938	117,000	[5] 413,799	89,654	[5] 439,657	87,000
Asia:						
India (British), nitrate of potash	11,063	4,640	7,110	2,980	(2)	(2)
Korea (Chosen), alunite	(2)	(2)	(2)	(2)	(2)	(2)
Palestine, crude potassium salts [6]	101,681	50,840	104,200	52,100	93,750	46,900
Australia, alunite	1,181	(2)	4,784	(2)	435	(2)
Total (estimated)		3,600,000		3,540,000		3,660,000

Country [1]	1944		1945		1946	
	Potassium salts	Equivalent K_2O	Potassium salts	Equivalent K_2O	Potassium salts	Equivalent K_2O
North America: United States, potassium salts	1,431,982	757,103	1,440,879	793,096	1,531,079	845,321
South America: Chile, crude potassium nitrate	(2)	(2)	(2)	(2)	(2)	(2)
Europe:						
France (Alsace), crude potassium salts	2,945,346	[3] 500,700	852,733	[3] 145,000	3,000,000	[3] 510,000
Germany, crude potassium salts:						
Carnallite [4]	15,861,933	1,925,530	(2)	(2)	(2)	(2)
Kainite, sylvinite, and hartsalz						
Spain, crude potassium salts	[5] 675,836	[7] 116,000	710,496	[7] 113,700	[8] 572,329	[7 8] 91,600
Asia:						
India (British), nitrate of potash	(2)	(2)	(2)	(2)	(2)	(2)
Korea (Chosen), alunite	12,000	(2)	(2)	(2)	(2)	(2)
Palestine, crude potassium salts [6]	105,050	52,500	(2)	(2)	(2)	(2)
Australia, alunite	1,598	(2)	22,616	(2)	(2)	(2)
Total (estimated)		3,410,000		1,410,000		2,240,000

[1] In addition to countries listed China, Eritrea, Iran, Italy, Poland, and U. S. S. R. are reported to produce potash salts, but statistics of production are not available..
[2] Data not available.
[3] Equivalent K_2O content estimated at approximately 17 percent.
[4] Includes some natural kieserite.
[5] Salable.
[6] Extracted from waters of Dead Sea.
[7] Unofficial estimate.
[8] January to September, inclusive.

Salt

By FLORENCE E. HARRIS AND E. M. TUCKER

GENERAL SUMMARY

THE United States produced 15,132,145 short tons of salt valued at $44,912,586 in 1946 compared with 15,394,141 tons valued at $43,914,406 in 1945, a 2-percent decrease in quantity. Compared by types with the output in 1945, evaporated salt increased 2 percent, and brine and rock salt each decreased 3 percent.

Owing to higher costs of containers, other supplies, and labor, the average value per ton increased from $2.85 in 1945 to $2.97 per ton in 1946, and therefore prices were forced higher in certain localities. At some of the salt mines strikes delayed production 1½ months. Other operations were affected by strikes in other industries.

Increased interest has been manifested in exporting domestic salt. Exports of salt were the highest in 1946 that they have ever been.

During the war years domestic salt replaced salt formerly imported for curing fish. In 1946, however, fish salt was again imported, and the quantity of domestic salt sold for the purpose decreased, the reduction being in rock salt.

Salient statistics of the salt industry in the United States, 1935–39 (average) and 1942–46

	1935–39 (average)	1942	1943	1944	1945	1946
Sold or used by producers:						
Evaporated (manufactured) short tons	2,507,374	3,517,832	[1] 3,476,501	[1] 3,448,578	[1] 3,182,570	3,249,457
In brine do	4,205,587	7,373,165	[1] 8,478,513	[1] 8,820,355	[1] 8,705,831	8,470,680
Rock salt do	1,947,254	2,802,287	3,259,138	3,448,238	3,505,740	3,412,008
Total:						
Short tons	8,660,215	13,693,284	15,214,152	15,717,171	15,394,141	15,132,145
Value [2]	$23,405,612	$38,144,234	[1] $41,529,688	[1] $43,715,492	[1] $43,914,406	$44,912,586
Average per ton [2]	$2.70	$2.79	[1] $2.73	[1] $2.78	[1] $2.85	$2.97
Imports for consumption:						
For curing fish short tons	[3] 21,250	[3] 6,434				1,407
Value	[3] $43,722	[3] $17,667				$5,011
In bags, barrels, etc. short tons	1,385	367	129	14	1,572	275
Value	$11,813	$4,138	$2,425	$700	$36,343	$4,456
In bulk short tons	24,131	953	1,129	5,540	2,981	2,571
Value	$55,876	$7,496	$10,325	$31,459	$37,047	$20,161
Total:						
Short tons	46,766	7,754	1,258	5,554	4,553	4,253
Value	$111,411	$29,301	$12,750	$32,159	$73,390	$29,628
Exports:						
Short tons	90,214	118,424	145,803	198,368	190,524	223,426
Value	$521,652	$892,160	$1,173,139	$1,620,226	$1,509,301	$1,889,522
Apparent consumption [4] short tons	8,616,767	13,582,614	15,069,607	15,524,357	15,208,170	14,912,972

[1] Revised.
[2] Values are f. o. b. mine or refinery and do not include cost of cooperage or containers.
[3] Includes salt in bags, sacks, barrels, or other packages—1938: 93 tons, $673; 1942: 122 tons, $1,200.
[4] Quantity sold or used by producers plus imports minus exports.

As shown in figure 1, salt in brine, which has been leveling off in the past few years, dropped only 6 points—to just above the 200 mark—whereas the index of industrial production dipped 33 points. The index for evaporated and rock salt declined only 1 point.

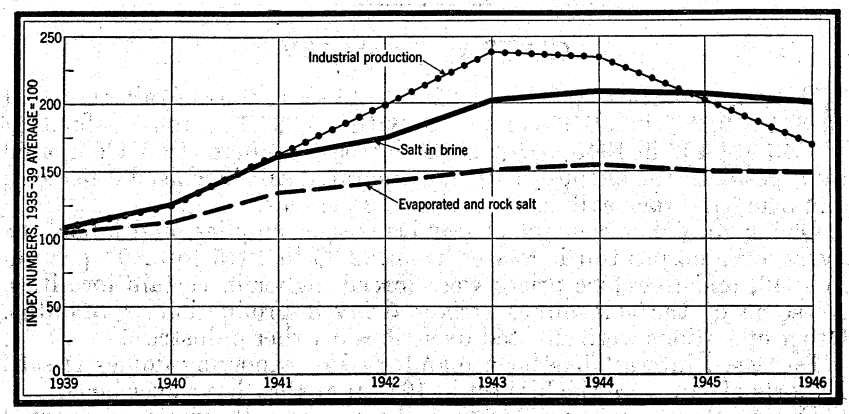

FIGURE 1.—Index of salt in brine and of evaporated and rock salt sold or used compared with industrial production, 1939–46. Index of industrial production from Federal Reserve Board.

Proportions of the three types of salt production are shown in figure 2, for 1939, the last normal prewar year, through 1946.

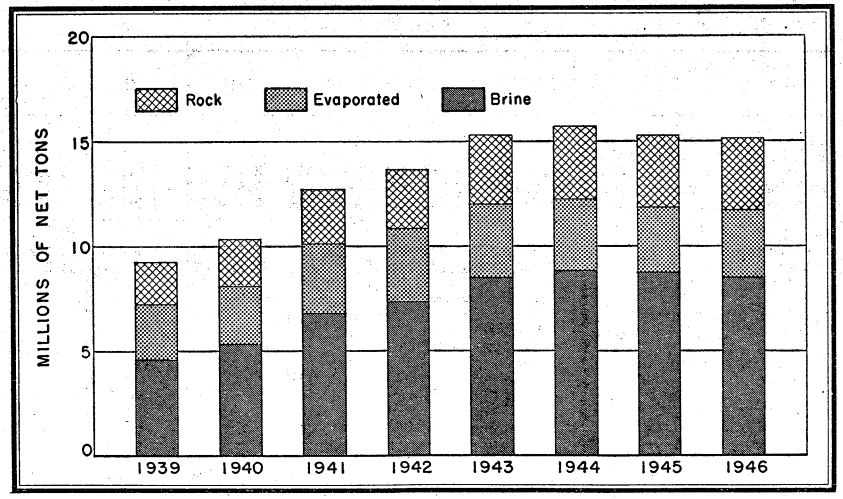

FIGURE 2.—Trends in the quantity of rock salt, evaporated salt, and brine (in terms of salt content) sold or used by producers in the United States, 1939–46.

PRODUCTION

PRODUCTION BY STATES

Salt was produced in the United States from underground mines, dry lakes, sea water, lake brine, springs, and wells, by 73 plants operated by 50 companies in 13 States and Puerto Rico in 1946 compared with 74 plants of 49 companies in 1945. Reports on salt in Ohio and Kansas were issued by the respective States.[1]

Salt sold or used by producers in the United States, 1944–46, by States

State	1944			1945			1946		
	Quantity		Value	Quantity		Value	Quantity		Value
	Short tons	Percent of total		Short tons	Percent of total		Short tons	Percent of total	
California	712,558	5	$3,138,185	694,609	4	$3,424,711	729,092	5	$3,358,060
Kansas	932,238	6	4,357,217	855,806	6	3,837,850	815,018	5	4,014,919
Louisiana	1,843,728	12	4,102,020	1,867,689	12	4,465,643	1,846,522	12	4,612,359
Michigan	4,287,758	27	14,921,719	4,285,493	28	14,942,443	4,334,202	29	15,711,074
New Mexico	23,759	(1)	105,860	9,980	(1)	20,694	8,677	(1)	16,399
New York	2,925,675	19	9,899,580	2,862,224	19	10,327,013	2,813,782	19	10,153,274
Ohio	2,891,395	18	4,076,481	2,764,926	18	3,997,759	2,645,995	17	4,160,011
Puerto Rico	13,620	(1)	87,114	12,513	(1)	81,200	12,411	(1)	83,494
Texas	1,147,397	7	[2] 1,353,756	1,100,791	7	[2] 1,336,162	1,098,589	7	1,356,676
Utah	119,809	1	368,500	122,997	1	363,997	121,669	1	339,505
West Virginia	359,217	2	1,027,109	370,260	2	903,759	272,841	2	896,894
Other States [3]	460,017	3	277,951	446,853	3	213,175	433,347	3	209,921
	15,717,171	100	[2] 43,715,492	15,394,141	100	[2] 43,914,406	15,132,145	100	44,912,586

[1] Less than 0.5 percent.
[2] Revised.
[3] Includes Nevada, Oklahoma, and Virginia.

California.—The new salt ponds of the Leslie Salt Co., which have been under construction for the past several years, are nearing completion. This extension, covering nearly 4,000 acres in the San Francisco Bay area, will supply the Redwood City plant with crude salt. It is expected that by 1950 the output from these new ponds will be about 150,000 short tons, most of which will be exported. No salt was produced at the Long Beach Salt Co, plant at Los Angeles. The lease was canceled and the plant closed July 1, 1946. The plant of the Monterey Bay Salt Works was destroyed by fire in November 1946. C. C. Miller has begun a salt works in marsh water in Mono County, near Bishop. No shipments of salt were made in 1946, as operations were on an experimental basis.

Kansas.—At the American Salt Corp., Lyons, rebuilding of the evaporating, refining, and packaging plant, which was destroyed by fire in June 1945, was not completed in 1946. Rock salt, however, was produced.

Louisiana.—The Gordy Salt Co. began operating a brine well at Breaux Bridge in 1943. (This fact was inadvertently omitted from a previous chapter.)

[1] Gambs, Gerard C., and White, George W., Ohio's Mineral Resources—III. Salt Reserves: Ohio State University Studies Eng. Ser., Eng. Exper. Sta. Circ. 49, vol. 15, No. 3, September 1946, 24 pp.
Taft, Robert, Kansas and the Nation's Salt: Trans. Kansas Acad. Science, vol. 49, No. 3, December 1946, pp. 223–272.

Nevada.—The Leslie Salt Co. plant on the dry lake at Fallon has been closed since hostilities terminated; however, the company reports a few sales for the convenience of neighbors.

Ohio.—The Pomeroy Salt Co. has been shut down temporarily.

West Virginia.—On April 1, 1946, the Pittsburgh Plate Glass Co. took over the Natrium plant at New Martinsville, formerly owned and operated by the Defense Plant Corporation.

PRODUCTION BY METHODS OF RECOVERY

The accompanying table shows the output of salt obtained by the various processes used in 1946.

Salt sold or used by producers in the United States, 1945–46, by method of recovery

Method of recovery	1945 [1]		1946	
	Short tons	Value	Short tons	Value
Evaporated:				
Bulk:				
Open pans or grainers	637,529	$5,961,143	558,026	$5,905,704
Vacuum pans	1,846,011	14,144,622	1,840,061	14,165,778
Solar	446,112	1,712,171	553,056	1,971,947
Pressed blocks	252,918	2,553,161	298,314	2,942,966
Rock:				
Bulk	3,410,929	12,115,237	3,314,948	12,479,589
Pressed blocks	94,811	849,154	97,060	828,412
Salt in brine (sold or used as such)	8,705,831	6,578,918	8,470,680	6,618,190
Total	15,394,141	43,914,406	15,132,145	44,912,586

[1] All data revised except quantity and value of rock salt and total quantity (but not value) sold or used.

Rock Salt.—The production of rock salt from 19 plants in 8 States totaled 3,412,008 short tons in 1946.

Rock salt sold by producers in the United States, 1942–46

Year	Short tons	Value	Year	Short tons	Value
1942	2,802,287	$9,623,461	1945	3,505,740	$12,964,391
1943	3,259,138	11,180,884	1946	3,412,008	13,308,801
1944	3,448,238	12,225,057			

Evaporated Salt.—In 1946, 49 plants in 12 States and Puerto Rico produced evaporated salt.

Evaporated salt sold or used by producers in the United States, 1945–46, by States

State	1945		1946	
	Short tons	Value	Short tons	Value
California	581,730	$3,114,191	595,747	$2,988,775
Kansas	337,697	2,676,919	338,532	2,829,111
Louisiana	65,264	548,922	87,834	584,815
Michigan	879,007	7,379,970	953,183	8,162,183
New York	490,246	5,347,891	466,115	5,025,740
Ohio	451,317	3,486,752	456,227	3,615,003
Puerto Rico	12,513	81,200	12,411	83,494
Utah	116,239	332,408	115,248	310,610
West Virginia	159,129	858,155	136,320	883,393
Other States [1]	[2] 89,428	[2] 544,689	87,840	503,271
	[2] 3,182,570	[2] 24,371,097	3,249,457	24,986,395

[1] Includes Nevada, New Mexico, Oklahoma, and Texas.
[2] Revised.

Pressed Blocks.—The all-time high total of 395,374 short tons of pressed blocks was manufactured by 21 evaporated-salt plants and 8 rock-salt plants in 1946.

Pressed-salt blocks sold by original producers of the salt in the United States, 1942–46

Year	From evaporated salt		From rock salt		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1942	240,354	$2,228,062	67,490	$569,014	307,844	$2,797,076
1943	269,064	2,598,873	77,912	668,027	346,976	3,266,900
1944	274,216	2,797,015	79,063	724,456	353,279	3,521,471
1945	242,632	2,479,109	94,811	849,154	337,443	3,328,263
1946	298,314	2,942,966	97,060	828,412	395,374	3,771,378

Salt Content of Brine.—Fifteen plants in 7 States produced brine salt in 1946. Although brine salt was down 3 percent from 1945, it contributed 56 percent of the total salt produced in 1946—the same percentage as in 1945. Demand for chlorine and soda ash continued strong during 1946. A backlog of orders piled up that could not be satisfied because of shortage of containers, transportation, and fuel. The bituminous-coal strike affected soda ash manufacture especially, inasmuch as it takes nearly a ton of coal to produce a ton of soda ash.[2]

DISTRIBUTION AND MARKETING

The accompanying table shows salt shipped to destinations within the State in which it is produced totaled with that shipped into the State from other sources. As reshipments are disregarded, the statistics represent only original shipments into States by producers.

Packages.—On September 1, 1946, the National Bureau of Standards issued Simplified Practice Recommendation R70–46 on "Salt Packages," which supersedes R70–42. (See Salt chapters of Minerals Yearbooks 1940 and 1941.) As the salt producers have found that the simple wartime standards resulted in substantial economies and in general benefits, it was decided to retain them.

Grades.—Although there is some call for standardization of sizes and grades, the descriptions given by distributors appear to answer the needs fairly well. Occasionally consumers require unusually strict specifications, and in such instances special precautions must be taken by the producer.

[2] Chemical and Metallurgical Engineering Flow Sheets, 1944, p. 61.

Distribution (shipments) of evaporated and rock salt in the United States, 1945–46, by States of destination, in short tons

Destination	1945		1946	
	Evaporated	Rock	Evaporated	Rock
Alabama	9,787	66,581	14,670	40,181
Arizona	14,453	4,734	17,011	4,614
Arkansas	8,285	47,730	11,625	30,144
California	367,377	59,326	365,791	65,079
Colorado	38,628	32,284	37,654	16,805
Connecticut	15,772	12,341	15,598	14,749
Delaware	5,261	11,292	4,283	14,519
District of Columbia	5,932	2,448	5,728	2,075
Florida	8,822	33,464	11,046	36,825
Georgia	20,366	57,976	22,669	57,888
Idaho	17,442	1,996	18,782	811
Illinois	228,687	221,495	241,328	207,409
Indiana	98,072	63,059	99,555	63,086
Iowa	112,764	102,199	116,272	95,402
Kansas	54,644	130,090	53,459	135,976
Kentucky	32,961	99,007	34,863	96,974
Louisiana	6,866	130,469	13,932	133,062
Maine	16,090	43,840	13,886	56,203
Maryland	41,106	44,568	40,337	25,473
Massachusetts	61,661	70,503	55,470	71,478
Michigan	143,708	65,146	145,865	75,871
Minnesota	115,982	73,024	119,168	72,192
Mississippi	3,874	32,494	10,421	33,212
Missouri	79,981	85,839	82,168	78,148
Montana	22,200	2,870	23,475	3,280
Nebraska	59,531	67,572	19,576	58,266
Nevada	7,006	51,759	40,083	66,208
New Hampshire	4,839	49,731	5,191	52,778
New Jersey	99,537	178,354	113,680	141,116
New Mexico	6,809	22,229	3,312	20,324
New York	239,407	524,577	230,705	503,452
North Carolina	58,401	47,110	55,047	56,866
North Dakota	11,782	5,225	12,677	4,952
Ohio	204,954	144,880	213,335	132,489
Oklahoma	29,659	36,019	32,050	32,841
Oregon	42,989	298	42,625	415
Pennsylvania	155,320	131,908	160,844	134,577
Rhode Island	9,642	12,307	10,169	11,601
South Carolina	11,786	20,648	12,633	24,157
South Dakota	24,177	18,472	25,106	17,142
Tennessee	24,642	63,659	30,139	64,407
Texas	[1] 66,871	250,170	71,243	239,236
Utah	27,890	2,405	25,077	2,635
Vermont	5,281	13,253	5,028	15,428
Virginia	55,830	83,931	56,507	95,634
Washington	137,618	1,569	161,809	1,525
West Virginia	172,647	75,883	155,284	80,755
Wisconsin	123,200	34,304	133,638	38,238
Wyoming	9,757	3,589	11,704	4,233
Other [2]	62,274	171,113	46,939	181,277
	[1] 3,182,570	3,505,740	3,249,457	3,412,008

[1] Revised figure.
[2] Includes salt used in Puerto Rico (evaporated salt), shipments to noncontiguous Territories of the United States, exports, and some shipments to unspecified destinations.

Salt shipped to noncontiguous Territories of the United States, 1944–46 [1]

Territory	1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value
Alaska	3,211	$75,157	[2] 3,952	$92,292	[2] 4,816	$111,965
American Samoa	9	431	9	459	6	338
Hawaii	2,572	76,675	4,830	143,933	2,528	91,790
Puerto Rico	2,806	98,654	8,959	293,594	4,741	170,798
Virgin Islands	90	4,073	95	5,408	76	4,730
Total	8,688	254,990	17,845	535,686	12,167	379,621

[1] Figures compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.
[2] Shipping weight; not strictly comparable to earlier years.

USES

In 1946, the first full year of peace after World War II, the most notable changes in the consumption of salt were decreases in brine used for soda ash and chlorine and in dry salt used for meat packing and fish curing. There were increases in the quantity used for livestock, textile processing, water treatment, table and household purposes, "other food processing," and hides and leather.

"Other uses" in the accompanying table includes synthetic rubber manufacture, the output of which declined in 1946. Exclusive of the salt used for chlorine for rubber manufacture, about 100,000 short tons of rock and evaporated salt were used for making synthetic rubber and rubber products. This is about half the quantity so used in 1945.

The use of salt for meat packing declined during the meat crisis of 1945–46, when there was a shortage of meat to be dressed. On the other hand, the quantity of salt used for livestock increased.

Salt sold or used by producers in the United States, 1945–46, by classes and uses, in short tons

Use	1945				1946			
	Evaporated	Rock	Brine	Total	Evaporated	Rock	Brine	Total
Chlorine, bleaches, chlorates, etc.	[1] 347,700	644,916	[1] 1,540,359	2,532,975	337,513	594,659	1,454,682	2,386,854
Soda ash	(2)		7,087,227	[2] 7,087,227			6,957,592	6,957,592
Dyes and organic chemicals	58,101	41,460		99,561	56,991	53,547		110,538
Soap (precipitant)	50,141	18,862	(3)	[3] 69,003	48,412	15,185		63,597
Other chemicals	105,363	441,579	(3)	[3] 546,942	104,484	430,987	(3)	[3] 535,471
Textile processing	35,968	101,378		137,346	37,050	121,176		158,226
Hides and leather	105,227	161,049		266,276	108,029	178,083		286,112
Meat packing	362,202	360,744		722,946	354,365	331,482		685,847
Fish curing	36,123	71,571		107,694	37,856	35,307		73,163
Butter, cheese, and other dairy products	112,087	5,592		117,679	121,447	5,647		127,094
Canning and preserving	156,713	16,164		172,877	167,249	21,725		188,974
Other food processing	230,993	22,243		253,236	240,799	24,885		265,684
Refrigeration	45,449	235,904		281,353	48,042	221,635		269,677
Livestock	539,929	192,817		732,746	599,537	192,344		791,881
Highways, railroads, dust and ice control	10,149	307,656		317,805	7,960	312,164		320,124
Table and other household	472,106	210,175		682,281	498,166	209,684		707,850
Water treatment	179,544	196,842	(3)	[3] 376,386	212,248	213,197	(3)	[3] 425,445
Agriculture	42,753	14,013		56,766	16,380	15,492		31,872
Metallurgy	28,922	29,000	(3)	[3] 57,922	17,566	31,403		48,969
Undistributed [4]	263,100	433,775	78,245	775,120	235,363	403,406	58,406	697,175
Total	[1] 3,182,570	3,505,740	[1] 8,705,831	15,394,141	3,249,457	3,412,008	8,470,680	15,132,145

[1] Revised figure.
[2] Data for evaporated salt included with "Undistributed."
[3] Data for salt in brine included with "Undistributed."
[4] Comprises miscellaneous uses and data not presentable by classes (footnotes 2 and 3), including most exports.

More dry salt was used for livestock than for any other purpose. The figures include not only the total pressed blocks but also an almost identical quantity in lumps and salt mixed in feed. Most of the cattle blocks are used in the Northeastern and Middle Western States, whereas much of the lump salt for livestock is consumed in parts of Texas and other southern areas. More than half of the livestock salt was supplied by Kansas, Texas, and Ohio, followed by New York,

Michigan, Louisiana, California, New Mexico, West Virginia, and Utah. The areas of maximum consumption naturally were the great cattle-raising sections.

Table salt is supplied chiefly by Michigan, New York, and Louisiana, and much smaller quantities by Ohio, California, Kansas, and West Virginia. Used everywhere in the United States, the greatest quantities are consumed in the largest centers of population.

Meat packing constitutes the third largest use of dry salt. A little over half was evaporated salt and the remainder rock salt. Kansas, New York, and Michigan supply most of the salt for this purpose, and Texas, Ohio, Louisiana, California, and West Virginia smaller quantities. Most of it is used in the great meat-packing centers in the Middle West and Northeast, and the remainder is scattered throughout the country.

Most salt-producing States supply salt for water treatment, but California greatly exceeds any other State. Substantial quantities are produced for this purpose in Ohio, New York, Louisiana, Michigan, Kansas, and Texas, with small amounts from West Virginia and New Mexico. It is consumed in every State, the quantity depending on the size of the industries and population.

Highways claim the next largest tonnage of dry salt. New York is the principal supplier of this material, with smaller amounts from Michigan, Kansas, Louisiana, Ohio, California, West Virginia, Utah, and Texas. Several magazine articles[3] have described methods of applying salt to city streets and roads.

Salt for curing hides and leathers is produced in New York (far in the lead), Kansas, California, Texas, Louisiana, Ohio, Michigan, and West Virginia.

Refrigeration consumes the next largest quantity of salt, most of which is produced in New York, California, Louisiana, and Texas, with less by Kansas, Michigan, Utah, Ohio, and West Virginia.

Salt for canning, dairy products, and other food processing is produced chiefly in Michigan, New York, and Ohio, and smaller quantities in Kansas, Louisiana, California, and West Virginia.

The source of supply of salt for canning and preserving was principally New York, Ohio, Michigan, California, Louisiana, Kansas, and some from West Virginia. This followed the pattern of the canning localities. Canneries abound in the Mid-Atlantic and Northeastern States. Many are found in the Middle Western States and along the Pacific coast. They are also scattered throughout the South but do not do the volume of business comparable to other sections as far as salt consumption goes. (Florida and Texas have large canning industries for citrus fruit juices but this requires less salt than meat and vegetable canning.)

Textile processing is carried on mainly in the New England and Southern States, although California does a certain amount. The salt for this processing is produced largely in New York and Louisiana and

[3] Warner, Carl D., Pre-Winter Snow Removal Plans; How Detroit is Making Sure Streets Will Be Open and Operating This Winter: American City, vol. 60, No. 10, October 1945, pp. 103–104.
Sevigny, Napoleon, Salt Speeds Up Ice Removal (Manchester, N. H.): American City, vol. 60, No. 11, November 1945, p. 112.
Public Works, Use of Rock Salt for Removing Ice and Snow From Streets: Vol. 77, No. 1, January 1946, pp. 19–20.

smaller quantities in Ohio, Michigan, California, and West Virginia.

The salt for butter and cheese is supplied principally by Michigan, New York, and Ohio, and smaller quantities by Kansas, California, Louisiana, and West Virginia.

The sources of salt used for fish curing have changed in the last decade because so much of it was imported formerly. During the last decade more domestic salt was used in curing fish in the United States, and less was imported. The domestic salt so used in 1946 was provided by New York, Ohio, California, Louisiana, and Michigan, and smaller quantities by Kansas, West Virginia, and Texas.

During 1942–46, as shown in the accompanying compilation, domestic salt used for fish curing increased materially, the peak year (1945) being 107,694 short tons. Although the total for 1946 was considerably less than in 1945, it surpassed every year before 1943.

Domestic salt sold or used by producers for fish curing, 1940–46, in short tons

Year	Evaporated	Rock	Total	Year	Evaporated	Rock	Total
1940	34,207	2,260	36,467	1944	35,998	67,844	103,842
1941	34,939	3,363	38,302	1945	36,123	71,571	107,694
1942	28,908	32,007	60,915	1946	37,826	35,307	73,133
1943	32,724	53,463	86,187				

Information on imports of this type of salt is presented in the foreign trade section of this report. How much of this market for domestic salt will remain permanently is uncertain. Fishermen in the Northeast customarily have used solar salt from the West Indies, but during World War II found themselves cut off from that source and turned to domestic supplies.

The foregoing review relates only to continental United States. Much of the salt produced in Puerto Rico is used for table-salt purposes, and some is used for curing hides, fish curing, soap manufacturing, refrigeration, and water treatment.

PRICES

Salt prices customarily are quoted f. o. b. point of delivery, hence, there is no uniform price list applicable to the entire country. The accompanying New York quotations from Oil, Paint and Drug Reporter indicate the price trend in recent years.

Average prices per short ton of salt (bagged) delivered New York City, 1939–46

	1939	1940	1941	1942	1943	1944	1945	1946
Rock salt:								
In carlots	$13.50	$13.45	$13.95	$14.20	$14.20	$14.20	$14.20	$14.20
Less than carlots	15.30	15.50	16.50	17.50	17.50	17.60	17.60	17.60
Vacuum common fine:								
In carlots	15.30	15.50	15.70	15.70	15.70	15.70	15.70	15.70
Less than carlots	18.65	18.15	19.70	21.30	21.30	21.40	21.40	21.40

FOREIGN TRADE [4]

Imports of salt declined, but exports increased in 1946 compared with 1945. Imports have declined steadily since 1939, until in 1946 they were less than 10 percent of the average for 1935–39. Exports, however, were 250 percent greater than the average for 1935–39. Nevertheless both are negligible compared with domestic production. Imports were only a small part of 1 percent and exports somewhat more than 1 percent.

Salt imported for consumption in the United States, 1942–46, by classes

Year	In bags, sacks, barrels, or other packages (dutiable)[1]		Bulk			
			Dutiable		Free (used in curing fish)	
	Short tons	Value	Short tons	Value	Short tons	Value
1942	367	$4,138	953	$7,496	[2] 6,434	[2] $17,667
1943	129	2,425	1,129	10,325		
1944	14	700	[3] 5,540	[3] 31,459		
1945	1,572	36,343	2,981	37,047		
1946	275	4,456	2,571	20,161	1,407	5,011

[1] Includes 98 pounds valued at $3 imported free in 1942, 12,939 pounds valued at $493 in 1943, 9,001 pounds valued at $356 in 1944, 1,500 pounds valued at $40 in 1945, and 2,000 pounds valued at $20 in 1946.
[2] Includes 122 tons ($1,200) in bags, barrels, or other packages.
[3] Includes 3,818,644 pounds valued at $9,244 imported free.

Salt imported for consumption in the United States, 1945–46, by countries

Country	1945		1946	
	Short tons	Value	Short tons	Value
North America:				
Canada	1,839	$21,913	2,067	$19,084
Curaçao (N. W. I.)	847	18,918	110	3,050
Dominican Republic	1,212	28,200		
Jamaica	522	3,345	2,075	7,464
Leeward and Windward Islands	133	1,014		
Europe:				
Switzerland			[1]	10
United Kingdom			1	20
	4,553	73,390	4,253	29,628

[1] Less than 1 ton.

Imports.—More than half of the salt imported in 1946 in bags, sacks, barrels, and other packages came from Canada. It entered through the Buffalo customs district and the Maine and New Hamp-

[4] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

shire district; only about one-half ton each came through the Vermont and Dakota districts. Puerto Rico received 110 tons from Curaçao (N. W. I.); San Francisco 1 ton from United Kingdom; and New York less than 1 ton from Switzerland.

In the bulk class (dutiable) Canada supplied 1,903 tons, of which 969 tons entered through Michigan customs and 934 tons through Buffalo customs. Jamaica supplied 668 tons through the Michigan customs.

In the bulk salt (duty-free) class for curing fish, Jamaica supplied the entire 1,407 tons through the Virginia customs.

Buying habits necessarily shifted during the war. This was especially noticeable in regard to imports of salt for curing fish. Before World War II, the largest part of the salt imported was used in fish curing. From 1938 to 1942, imports of this type of salt in bulk were as follows:

Year	Short tons	Value	Including salt in bags, sacks, barrels, and other packages
1938	21,010	$47,800	93 tons valued at $673.
1939	15,461	27,700	None.
1940	12,965	25,174	6 tons valued at $12.
1941	7,426	30,058	None.
1942	6,434	17,667	122 tons valued at $1,200.

In 1943, 1944, and 1945 no imports of fish salt were recorded, but in 1946 bulk salt for curing fish again appeared in the customs records. During 1943–45, as seen by the figures given in the Uses section of this chapter, the use of domestic salt for curing fish increased materially; 107,694 tons were consumed for this purpose in the peak year 1945.

Exports.—In the past year interest in salt exports has quickened. This applies not only to crude and refined table salt but also to pressed blocks for consumption by livestock. In 1946 exports of salt were the highest they have ever been.

The customs districts, from which the salt exports shown in the accompanying table were made, are indicative of the area in which the salt originated. A review of shipments, by customs districts, shows that about 73 percent was shipped through Great Lakes and St. Lawrence ports; 8 percent through Pacific districts; 5 percent through North Atlantic States; 5 percent through Gulf ports, including Florida; 4 percent through the southern border States Arizona and Texas; 3 percent through the Middle and South Atlantic States; and 1.5 percent through northwestern border States—Dakota, and Montana and Idaho.

Salt exported from the United States, 1945–46, by countries

Country	1945		1946	
	Short tons	Value	Short tons	Value
North America:				
Bermuda	30	$1,427	26	$1,377
Canada	149,658	865,947	182,764	1,130,780
Central America:				
British Honduras	428	5,616	625	7,975
Costa Rica	109	1,994	189	5,267
Guatemala	10	450	49	1,435
Honduras	210	3,905	261	7,176
Nicaragua	196	3,556	412	9,697
Panama:				
Canal Zone	530	18,142	1,243	42,792
Republic of	60	1,732	64	1,817
Greenland	2,477	22,655		
Iceland	2	125		
Mexico	7,628	152,861	10,912	213,342
Newfoundland and Labrador	7,748	56,271	6,465	45,143
West Indies:				
British:				
Barbados	6	215		
Jamaica	311	4,109	675	10,239
Trinidad and Tobago	74	1,884		
Other British	50	1,761	58	1,574
Cuba	5,967	81,226	5,194	75,435
Curaçao (N. W. I.)	235	7,448	209	10,076
Dominican Republic	19	902	151	6,144
Haiti	18	1,057	8	612
Other North America	150	2,789	91	1,930
South America:				
Argentina	(1)	3	77	1,206
Brazil	3,738	117,772	1,321	40,817
British Guiana	2	47		
Colombia	1	135	1	82
Ecuador	(1)	31	148	2,227
Surinam	275	5,657	250	4,652
Venezuela	147	5,885	61	3,052
Other South America	9	854	40	945
Europe:				
Belgium and Luxembourg	8,482	81,324	4,283	41,065
Czechoslovakia	6	2,981	2,779	62,885
U. S. S. R.	(1)	6		
Yugoslavia	61	2,408	2,655	72,779
Other Europe	17	5,882	49	3,441
Asia:				
Bahrein, State of	305	5,258	12	1,008
China	(1)	189	152	6,524
Hong Kong	10	200	281	7,362
India and Dependencies	2	130		
Philippines, Republic of	243	9,266	636	23,908
Other Asia	14	1,063	34	1,710
Africa:				
Algeria	4	266		
Liberia	540	14,757	827	26,390
Union of South Africa	442	10,780	143	7,132
Other Africa	10	911	50	3,805
Oceania:				
British: New Zealand	4	64		
French	296	7,358	231	5,721
Japanese Mandated Islands	(1)	2		
	190,524	1,509,301	223,426	1,889,522

[1] Less than 1 ton.

WORLD REVIEW

A great many countries contribute to total world production of salt, but the output of the United States far exceeds all. Other countries high on the list are Germany, United Kingdom, China, Italy, France, and India.

World production of salt, 1939–46, by countries, in metric tons [1]

[Compiled by P. Roberts]

Country [1]	1939	1940	1941	1942	1943	1944	1945	1946
North America:								
Canada	385,550	420,974	510,930	591,343	619,528	632,841	610,601	481,032
Costa Rica	6,822	6,800	6,000	7,727	3,414	6,197	6,033	8,000
Guatemala	(2)	(2)	(2)	11,765	12,618	12,645	(2)	(2)
Honduras	(2)	(2)	(2)	3,400	2,500	2,700	900	850
Mexico	(2)	(2)	(2)	584,000	744,000	(2)	(2)	(2)
Nicaragua	(2)	(2)	(2)	[3] 6,000	[3] 6,000	(2)	[3] 6,000	(2)
Panama	4,536	5,199	(2)	9,526	----------	10,000	2,437	7,958
United States:								
Rock salt	1,846,254	2,055,260	2,375,983	2,542,179	2,956,625	3,128,173	3,180,337	3,095,305
Other salt	6,570,481	7,343,089	9,163,917	9,880,094	10,845,349	11,130,131	10,784,940	10,632,274
West Indies:								
British:								
Bahamas	11,600	27,000	25,400	6,170	790	60,960	38,825	(2)
Turks and Caicos Islands	[4] 47,389	[4] 67,028	[4] 48,179	[4] 15,581	[4] 8,512	33,779	21,229	31,571
Cuba	113,398	41,246	41,909	43,545	18,416	15,422	63,504	58,967
Dominican Republic	9,536	7,500	14,700	5,590	12,620	11,300	15,100	15,750
Haiti [3]	12,600	10,500	2,100	(2)	8,000	8,000	8,000	(2)
Netherlands West Indies [4]	247	37	3,226	4,574	4,792	5,150	3,109	(2)
South America:								
Argentina:								
Rock salt	700	350	860	355	751	2,237	(2)	(2)
Other salt	303,321	292,307	372,689	364,279	441,016	449,038	(2)	[3] 400,000
Brazil	564,330	398,538	550,000	598,537	416,121	453,601	(2)	(2)
Chile	39,593	44,317	57,185	55,578	37,111	45,691	47,760	(2)
Colombia:								
Rock salt	3,950	4,703	4,530	4,816	5,260	133,862	105,072	124,367
Other salt	[3] 101,400	105,050	80,316	103,938	107,575			
Ecuador	16,145	29,900	20,207	24,893	11,947	35,958	27,600	35,070
Peru	42,030	49,053	46,855	45,838	49,027	53,818	55,143	[3] 55,000
Venezuela	20,473	52,540	40,193	17,837	33,838	[3] 25,000	44,166	90,555
Europe:								
Austria:								
Rock salt	1,476	1,017	536	421	381	3,600	(2)	554
Other salt	261,243	238,384	272,600	247,612	240,656	247,414	82,648	168,150
Bulgaria:								
Rock salt	13,168	15,000	(2)	(2)	(2)	(2)	(2)	13,659
Other salt	(2)	65,000	(2)	(2)	(2)	(2)	(2)	(2)
Czechoslovakia [5]	(2)	5,800	10,000	(2)	(2)	(2)	5,000	(2)
France:								
Rock salt and salt from springs	1,756,830	1,160,300	1,283,880	1,151,890	1,143,080	546,323	559,968	1,211,255
Other salt	378,520	460,080	576,100	557,860	561,010	410,506	(2)	(2)
Germany:								
Rock salt	3,094,127	3,397,962	3,662,968	4,126,534	[3] 4,000,000	[3] 3,520,000	(2)	(2)
Other salt	625,060	690,715	665,456	569,393	[3] 550,000	[3] 500,000	(2)	(2)
Greece	82,425	75,000	59,000	72,000	71,000	21,000	90,000	105,000
Hungary [6]	63,600	153,140	254,690	302,950	341,690	(2)	(2)	(2)
Italy:								
Rock salt	682,589	685,295	720,510	(2)	(2)	(2)	(2)	(2)
Other salt	682,519	735,504	756,134	(2)	(2)	(2)	(2)	(2)
Malta	1,753	(2)	(2)	(2)	(2)	3,350	3,350	(2)
Netherlands	199,800	209,368	156,200	193,800	193,706	124,184	53,600	(2)
Poland	[3] 650,000	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Portugal:								
Rock salt	36,000	65,000	61,000	(2)	73,000	(2)	71,000	46,000
Other salt	[3] 235,000	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Rumania: Rock salt	374,682	317,969	268,993	360,394	360,240	154,090	277,183	(2)
Spain:								
Rock salt	157,784	206,650	195,686	248,302	266,226	243,076	228,029	262,651
Other salt	661,269	463,795	358,217	405,665	500,392	449,058	562,453	510,121
Switzerland	90,000	77,000	67,000	71,000	74,000	72,000	81,113	93,000
United Kingdom:								
Great Britain:								
Rock salt	23,697	26,449	23,294	27,401	21,514	17,771	17,062	(2)
Other salt	3,230,012	3,403,966	3,421,989	3,626,385	3,406,017	3,407,791	3,268,083	(2)
Ireland, Northern [7]	10,740	13,948	13,607	13,499	11,183	11,220	12,679	(2)
Yugoslavia	54,213	(2)	(2)	[3] 28,000	(2)	(2)	(2)	(2)

See footnotes at end of table.

World production of salt, 1939–46, by countries, in metric tons [1]—Continued

Country [1]	1939	1940	1941	1942	1943	1944	1945	1946
Asia:								
Aden	294,077	258,714	181,873	70,107	202,434	208,603	142,191	114,856
Burma	(2)	(2)	[9] 91,000	(2)	(2)	(2)	(2)	[3] 56,000
Ceylon	36,130	33,798	28,511	18,678	13,781	28,686	42,364	43,666
China	2,933,183	3,659,824	4,599,780	5,197,914	[10] 1,516,805	[10] 1,004,248	[10] 800,435	[10] 2,267,345
India:								
Rock salt	196,503	207,294	195,890	219,481	332,843	233,339	256,366	(2)
Other salt	1,326,544	1,464,648	1,611,640	1,702,845	1,624,976	1,661,315	1,974,788	(2)
Indochina, French	213,526	189,350	(2)	(2)	(2)	(2)	(2)	(2)
Iraq:								
Rock salt	(2)	(2)	(2)	(2)	(2)	(2)	2,521	2,521
Other salt	9,107	8,331	10,303	11,604	21,356	11,792	12,364	12,364
Japan [11]	636,382	573,581	389,441	475,418	415,442	353,153	193,845	(2)
Korea (Chosen)	(2)	(2)	(2)	(2)	[3] 350,000	(2)	(2)	(2)
Netherlands Indies	[12] 141,208	[12] 388,837	(2)	(2)			(2)	(2)
Palestine:								
Rock salt	645	599	576	1,886	1,822	1,181	2,144	(2)
Other salt	8,736	9,944	10,965	10,705	17,955	19,055	16,350	(2)
Philippines, Republic of	(2)	17,000	(2)	(2)	(2)	(2)	(2)	(2)
Portuguese India	27,979	38,564	[4] 10,070	[4] 13,672	[4] 10,290	19,144	[4] 9,146	[4] 15,428
Siam (Thailand) [4 9]	95,170	112,197	(2)	(2)	(2)	(2)	(2)	(2)
Syria	[3] 10,000	[3] 10,000	[3] 20,000	[3] 20,000	17,099	21,783	[3] 12,000	[3] 34,000
Turkey:								
Rock salt	(2)	19,621	22,350	22,105	22,976	266,330	16,193	225,917
Other salt	(2)	193,213	173,898	202,861	243,353		255,303	
Africa:								
Algeria	68,440	73,440	68,440	60,650	25,820	50,937	49,969	
Belgian Congo		1,038	1,159	1,191		1,711		739
Canary Islands [3]	2,000	2,000	(2)	(2)	(2)	(2)	(2)	(2)
Egypt (exports)	442,532	206,211	155,123	100,716	106,901	199,116	255,107	226,090
Eritrea	77,269	50,116	2,689	4,419	8,101	10,721	[3] 35,000	140,000
Ethiopia: Rock salt [3]	10,000	10,000	10,000	10,000	10,000	(2)	(2)	(2)
French West Africa [3]	(2)	(2)	(2)	40,000	48,000	53,000	55,000	55,000
Kenya	5,318	9,425	14,177	13,694	15,318	14,054	15,491	15,635
Libya:								
Cyrenaica [3]	10,000	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Tripolitania [3]	15,000	15,000	15,000	15,000				(2)
Mauritius [3]	1,500	1,500	(2)	(2)	(2)	(2)	(2)	(2)
Morocco, French:								
Rock salt	1,400	1,546	6,587	10,934	12,208	34,945	12,930	10,584
Other salt	13,400	23,605	27,150	32,988	31,963			
Nigeria [3]	400	400	(2)	(2)	(2)	(2)	(2)	(2)
Portuguese East Africa	6,628	251	7,505	2,562	379	221	10	71
Portuguese West Africa	22,970	29,148	40,305	45,145	43,419	37,652	49,552	61,657
Somaliland:								
British (exports)	629							(2)
French	78,116	18,499	3,310	200	22,244	42,657	55,000	45,000
Italian	160,000	(2)	(2)	(2)	(2)	(2)	(2)	(2)
South-West Africa:								
Rock salt	751	1,125	1,654	2,090	2,096	2,870	3,238	3,533
Other salt	4,704	5,364	7,811	8,314	8,616	9,049	10,011	10,590
Sudan, Anglo-Egyptian	40,633	40,471	40,668	39,630	40,488	35,969	44,471	40,982
Tanganyika	9,997	8,817	8,318	8,973	11,542	11,214	[4] 2,687	12,808
Tunisia	106,310	122,267	107,667	62,120	10,053	52,478	61,289	(2)
Uganda	2,626	3,374	4,314	4,212	5,243	(2)	(2)	5,679
Union of South Africa	[3] 100,000	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Australia:								
South Australia	80,759	146,991	173,431	176,972	187,270	167,531	173,813	160,753
Total [13]	31,972,000	33,199,000	36,706,000	38,577,000	36,008,000	33,693,000	31,796,000	35,545,000

[1] In addition to the countries listed salt is produced in Albania, Bolivia, Cyprus, Formosa (Taiwan), Gold Coast, Leeward Islands, Madagascar, Southern Rhodesia, U. S. S. R., and other Australian States (Victoria and Western Australia), but figures of production are not available. Russian production, however, is known to exceed 4½ million metric tons annually.

[2] Data not available. [3] Estimate. [4] Exports.

[5] Estimated. Excludes Sub-Carpathia, ceded to Hungary and U. S. S. R.

[6] Includes Northern Territories and Sub-Carpathia; in addition, beginning in 1941 includes Eastern Hungary and Transylvania, and beginning in 1942 includes Southern Territories.

[7] Excluding rock salt. [8] January to June, inclusive; Croatia only.

[9] Fiscal year ended March 31 of year stated.

[10] Data represents areas designated as Free China during the period of Japanese occupation.

[11] Fiscal year ended March 31 of year following that stated. [12] Incomplete data.

[13] Estimated by author of chapter; excludes estimates for countries listed in footnote 1.

The accompanying world production table contains foreign salt statistics that have been lacking for several years. Notable among these are figures for France (1939–46); Greece (1940–46); India (final 1944, and 1945); Japan (1939–45); Rumania (1944–45); and United Kingdom (1939–45). The output for Japan in 1938, not shown in this or previous tables, was 483,601 metric tons for its fiscal year, ended March 31, 1938.

Detailed information on the salt industries in foreign countries was published in Mineral Trade Notes as follows: Argentina,[5] Australia,[6] Austria,[7 8] Belgium,[9] Brazil,[5 9] Canada,[6 10 11 12] Ceylon,[9 12] China,[11 12] Colombia,[7] Czechoslovakia,[13] Denmark,[8 13] Dominican Republic,[10 14] Ecuador,[14] Egypt,[15] France,[13] Hungary,[13] Italy,[14] Kenya,[6 14] Japan,[8 16] Korea,[5] Mexico,[6 14 16 17] Newfoundland,[7] Panama,[14] Portugal,[7] Peru,[11] Rumania,[13] South-West Africa,[6] Spain,[7] Syria,[9 14] Turkey,[7 10] Turks and Caicos Islands,[7] and United Kingdom.[13]

A report [18] translated from the China Newsweek describes the salt wells of Szechwan, China.

Denmark.—Discovery of the first known occurrence of rock salt in Denmark was made on June 3, 1946, about 5 miles north of Holstebro in northwestern Jutland. This is very important to Denmark, inasmuch as in the past all salt requirements have been imported.

Japan.—Japan needed salt so desperately, particularly for salting fish, that early in 1946, several ferro-alloy plants were converted to making salt for domestic consumption and fish salting.[19] This was done by evaporating sea water in wooden tanks placed in open furnaces, filling them with sea water, then lowering electrodes into the tanks. It was acknowledged that the method was crude and wasted power, but was the best possible in the situation. Estimates indicate that about 20 percent of all salt recovered in the country by evaporating sea water is in the Heroult-type electric furnace.

Mexico.—The Lake Texcoco solar salt development, Mexico City Mexico,[20] is now evaporating 40,000 cubic feet of water per day and 10 tons a day of the concentrated solution is being pumped from the center of the caracol (snail, from its shape).

[5] Vol. 23, No. 5, November 1946, pp. 48–49.
[6] Vol. 23, No. 6, December 1946, pp. 47–51.
[7] Vol. 23, No. 3, September 1946, pp. 41–53.
[8] Vol. 24, No. 3, March 1947, pp. 45–47.
[9] Vol. 24, No. 4, April 1947, pp. 30–32.
[10] Vol. 22, No. 4, April 1946, pp. 45–47.
[11] Vol. 22, No. 6, June 1946, pp. 37–44
[12] Vol. 24, No. 2, February 1947, pp. 47–49.
[13] Vol. 24, No. 1, January 1947, pp. 55–66
[14] Vol. 22, No. 2, February 1946, pp. 51–52.
[15] Vol. 22, No. 1, January 1946, p. 53.
[16] Vol. 23, No. 2, August 1946, pp. 40–43.
[17] Vol. 22, No. 3, March 1946, pp. 36–41.
[18] Mining Journal (London), Salt Wells in Szechwan: Vol. 226, No. 5775, Apr. 27, 1946, p. 325.
[19] Bardill, John D. (scientific consultant, Mining and Geology Div., General Headquarters, Supreme Commander for Allied Powers), Ferro Alloy Metallurgy in Japan: Nat. Resources Sec. Rept. 62, December 5, 1946, p. 8 and p. 14, reproduced in Spec. Sup. 14, Mineral Trade Notes, vol. 24, No. 5, May 1947 (p. 2 and p. 11).
[20] Chemical and Metallurgical Engineering, vol. 53, No. 6, June 1946, p. 126.

Sand and Gravel

By G. RICHARDS GWINN AND G. E. TUCKER

GENERAL SUMMARY

THE SAND and gravel and iron blast-furnace slag industries in 1946 had a prosperous year due primarily to the expanding construction program. As shown in figure 1, output of sand and gravel exceeded the production of any other peacetime year, being topped only by 1941 and 1942 in quantity and 1942 in value.

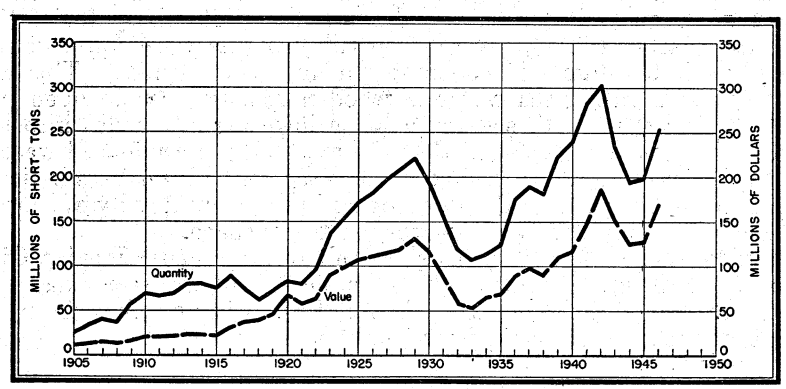

FIGURE 1.—Production of sand and gravel in the United States, 1905–46.

As stocks of sand and gravel are relatively small and constant from year to year, production virtually equals sales. Thus these terms are used interchangeably in this report.

As shown in the accompanying salient-statistics table, sales in 1946 of all kinds of sands by commercial operators, with the exception of molding, fire or furnace, and railroad-ballast, increased over those reported in 1945; sales of gravel by this class of operators, with the exception of railroad ballast, also increased. The combined total of sand and gravel used on Government-and-contractor operations also shows an increase in 1946. The upward trend, however, was accounted for entirely by gravel operations, as the quantity of sand utilized was 15 percent below that reported in 1945.

Sand and gravel sold or used by producers in the United States, 1945–46, by commercial and Government-and-contractor operations and by uses

	1945			1946			Percent of change in—	
	Short tons	Value		Short tons	Value		Tonnage	Average value
		Total	Average		Total	Average		
COMMERCIAL OPERATIONS								
Sand:								
Glass	4,681,920	$8,374,218	$1.79	4,848,602	$9,541,405	$1.97	+3.6	+10.1
Molding	7,190,856	9,724,750	1.35	6,973,906	9,531,263	1.37	−3.0	+1.5
Building	30,490,146	18,812,208	.62	48,237,949	31,653,529	.66	+58.2	+6.5
Paving	16,681,521	10,428,371	.63	24,360,044	16,373,892	.67	+46.0	+6.3
Grinding and polishing [1]	642,511	1,029,501	1.60	906,889	1,379,954	1.52	+41.1	−5.0
Fire or furnace	308,997	387,872	1.26	248,866	333,643	1.34	−19.5	+6.3
Engine	2,771,896	1,924,725	.69	2,797,132	1,924,779	.69	+.9	------
Filter	109,845	231,026	2.10	157,511	284,991	1.81	+43.4	−13.8
Railroad ballast [2]	1,082,626	400,762	.37	714,884	262,089	.37	−34.0	------
Other [3]	1,116,353	1,117,153	1.00	1,548,620	1,747,921	1.13	+38.7	+13.0
Total commercial sand	65,076,671	52,430,586	.81	90,794,403	73,033,466	.80	+39.5	−1.2
Gravel:								
Building	27,910,042	21,735,554	.78	40,424,515	32,958,822	.82	+44.8	+5.1
Paving	36,759,164	25,693,994	.70	46,894,010	34,325,134	.73	+27.6	+4.3
Railroad ballast [4]	20,657,982	9,518,328	.46	12,009,960	6,341,133	.53	−41.9	+15.2
Other [5]	1,734,439	1,043,910	.60	1,969,678	1,438,147	.73	+13.6	+21.7
Total commercial gravel	87,061,627	57,991,786	.67	101,298,163	75,063,236	.74	+16.4	+10.4
Total commercial sand and gravel	152,138,298	110,422,372	.73	192,092,566	148,096,702	.77	+26.3	+5.5
GOVERNMENT-AND-CONTRACTOR OPERATIONS [6]								
Sand:								
Building	1,018,000	428,000	.42	894,000	313,000	.35	−12.2	−16.7
Paving	5,631,000	1,998,000	.35	4,752,000	1,629,000	.34	−15.6	−2.9
Total Government-and-contractor sand	6,649,000	2,426,000	.36	5,646,000	1,942,000	.34	−15.1	−5.6
Gravel:								
Building	2,145,000	1,225,000	.57	2,752,000	1,416,000	.51	+28.3	−10.5
Paving	34,592,000	14,764,000	.43	53,641,000	19,932,000	.37	+55.1	−14.0
Total Government-and-contractor gravel	36,737,000	15,989,000	.44	56,393,000	21,348,000	.38	+53.5	−13.6
Total Government-and-contractor sand and gravel	43,386,000	18,415,000	.42	62,039,000	23,290,000	.38	+43.0	−9.5
COMMERCIAL AND GOVERNMENT-AND-CONTRACTOR OPERATIONS								
Sand	71,726,000	54,856,000	.76	96,440,000	74,975,000	.78	+34.5	+2.6
Gravel	123,798,000	73,981,000	.60	157,691,000	96,411,000	.61	+27.4	+1.7
Grand total	195,524,000	128,837,000	.66	254,131,000	171,386,000	.67	+30.0	+1.5

[1] Includes blast sand as follows—1945: 318,390 tons valued at $766,013; 1946; 292,899 tons, $736,819.
[2] Includes ballast sand produced by railroads for their own use as follows—1945: 17,792 tons valued at $2,429; 1946: 83,422 tons, $10,562.
[3] Includes some sand used by railroads for fills and similar purposes as follows—1945: 220,244 tons valued at $44,356; 1946: 164,061 tons, $30,658.
[4] Includes ballast gravel produced by railroads for their own use as follows—1945: 8,587,465 tons valued at $2,987,940; 1946: 4,077,115 tons, $1,640,726.
[5] Includes some gravel used by railroads for fills and similar purposes as follows—1945: 843,969 tons valued at $133,494; 1946: 637,462 tons, $107,938.
[6] Approximate figures for States, counties, municipalities, and other Government agencies directly or under lease.

PRODUCTION

The production of sand and gravel in 1946 reached 254,131,000 short tons valued at $171,386,000, an increase of 30 percent in quantity and 33 percent in value over the 195,524,000 tons valued at $128,837,000 reported in 1945. The largest increases were reported for sand and gravel utilized in building, which reflect the great expansion of the construction industry.

California in 1946, as in 1945, was the largest producer, and Illinois, Michigan, Wisconsin, Ohio, New York, Texas, Minnesota, and Pennsylvania follow in that order. These 9 States, each with an output of more than 10,000,000 tons, accounted for 52 percent of the total production. The following tables show details of production, by States and uses, in 1946.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States, 1942–46

Year	Sand		Gravel (including railroad ballast)		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1942	107,371,000	$74,443,000	196,975,000	$114,057,000	304,346,000	$188,500,000
1943	82,053,000	62,263,000	152,011,000	90,530,000	234,064,000	152,793,000
1944	68,978,000	54,054,000	125,805,000	71,110,000	194,783,000	125,164,000
1945	71,726,000	54,856,000	123,798,000	73,981,000	195,524,000	128,837,000
1946	96,440,000	74,975,000	157,691,000	96,411,000	254,131,000	171,386,000

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1946, by States

State	Short tons	Value	State	Short tons	Value
Alabama	2,923,240	$1,937,576	Nevada	720,506	$944,332
Alaska	(1)	(1)	New Hampshire	[1] 1,434,880	[1] 138,789
Arizona	1,098,791	974,347	New Jersey	5,123,324	5,404,206
Arkansas	[1] 2,203,647	[1] 1,821,423	New Mexico	[1] 349,688	[1] 278,442
California	27,220,849	18,396,460	New York	12,079,249	8,907,100
Colorado	2,532,946	1,796,395	North Carolina	4,213,795	2,933,711
Connecticut	2,199,654	1,221,839	North Dakota	2,304,694	726,422
Delaware	187,229	123,532	Ohio	13,266,074	11,105,652
Florida	1,534,667	1,320,819	Oklahoma	1,577,138	947,283
Georgia	893,290	523,102	Oregon	5,419,183	4,578,672
Hawaii	(1)	(1)	Pennsylvania	10,773,213	10,984,330
Idaho	2,082,874	1,572,088	Puerto Rico	(1)	(1)
Illinois	16,771,242	11,458,969	Rhode Island	[1] 41,659	[1] 8,486
Indiana	8,752,267	5,656,047	South Carolina	524,271	214,964
Iowa	7,938,572	3,059,792	South Dakota	3,215,608	1,537,822
Kansas	4,443,086	2,505,822	Tennessee	4,011,591	3,632,603
Kentucky	2,163,734	1,802,063	Texas	11,188,849	8,086,097
Louisiana	3,385,097	3,080,215	Utah	1,653,010	992,083
Maine	2,834,360	925,308	Vermont	383,576	241,289
Maryland	4,001,071	3,720,103	Virginia	5,340,372	4,319,125
Massachusetts	4,641,685	2,909,784	Washington	7,557,707	4,608,392
Michigan	15,593,456	8,939,969	West Virginia	3,457,372	4,518,325
Minnesota	10,814,635	3,221,434	Wisconsin	14,828,713	6,802,828
Mississippi	2,619,293	1,533,631	Wyoming	2,005,951	1,129,598
Missouri	5,136,904	4,070,448	Undistributed [1]	4,290,000	2,510,000
Montana	2,428,681	1,301,867			
Nebraska	3,969,811	1,962,560		254,131,000	171,386,000

[1] Output of commercial producers in Alaska, New Hampshire, and Rhode Island and of Government-and-contractor operations in Alaska, Arkansas, Hawaii, New Mexico, and Puerto Rico comprise "Undistributed."

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1946, by States and uses

[Commercial unless otherwise indicated]

State	Sand							
	Glass		Molding		Building			
					Commercial		Government-and-contractor	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			77,292	$86,789	568,487	$400,759	202	$52
Alaska							(1)	(1)
Arizona					218,487	210,666	10,500	10,500
Arkansas	(1)	(1)	(1)	(1)	429,586	297,434		
California	(1)	(1)	(1)	(1)	7,568,095	4,639,533	62,243	31,173
Colorado			354	708	341,363	171,288	54,449	52,945
Connecticut	(1)	(1)	(1)	(1)	639,948	397,344	451,202	34,015
Delaware	100	$40	(1)	(1)	19,723	12,963		
Florida					790,061	597,565		
Georgia	6,370	10,192	20,554	5,832	457,016	222,770		
Hawaii								
Idaho					108,486	98,915	14,367	1,020
Illinois	(1)	(1)	1,196,889	1,501,175	2,980,855	1,619,696		
Indiana			527,282	369,386	1,150,151	720,065	2,700	500
Iowa			(1)	(1)	1,075,408	626,579	25,727	4,217
Kansas					973,981	544,167	4,537	690
Kentucky			(1)	(1)	581,264	501,925	55	146
Louisiana			(1)	(1)	675,242	421,936		
Maine					71,867	29,572	1,498	777
Maryland	(1)	(1)			728,415	637,912		
Massachusetts			(1)	(1)	1,360,508	872,577	6,840	4,740
Michigan	119,172	248,049	1,302,839	672,314	1,971,634	1,148,049	5,455	322
Minnesota	(1)	(1)	4,560	6,419	1,198,820	525,804	18,685	17,756
Mississippi			38,406	34,139	365,293	184,455		
Missouri	408,510	731,945	77,346	113,351	1,325,414	895,859	13,500	7,500
Montana					95,909	103,193		
Nebraska					335,219	149,670	4,253	1,023
Nevada	(1)	(1)	(1)	(1)	98,427	87,235		
New Hampshire					(1)	(1)		
New Jersey	(1)	(1)	1,329,309	2,261,284	1,590,864	995,144		
New Mexico					(1)	(1)	(1)	(1)
New York			495,099	900,274	4,499,861	2,883,263	189	70
North Carolina					820,553	365,333		
North Dakota					(1)	(1)	2,700	200
Ohio	(1)	(1)	707,031	1,365,222	3,269,624	2,336,652	270	80
Oklahoma	(1)	(1)			322,946	159,620		
Oregon					622,675	613,405	14,127	13,676
Pennsylvania	(1)	(1)	301,764	547,047	2,815,251	2,622,195		
Puerto Rico							(1)	(1)
Rhode Island			(1)	(1)	(1)	(1)		
South Carolina					223,225	82,792		
South Dakota					85,370	57,472	1,132	370
Tennessee	25,498	50,996	205,508	432,397	958,937	939,183	75,571	12,944
Texas	(1)	(1)	(1)	(1)	2,447,585	1,511,722	5,653	3,747
Utah			945	875	269,788	156,839	7,592	7,478
Vermont			81	60	1,617	1,138		
Virginia	(1)	(1)	14,570	21,328	728,841	628,643	2,662	3,502
Washington			(1)	(1)	1,019,244	691,537	55,855	59,820
West Virginia	(1)	(1)	(1)	(1)	434,917	416,138		
Wisconsin			(1)	(1)	1,611,754	802,364	14,934	4,506
Wyoming					22,927	34,981	3,549	5,765
Undistributed [1]	4,288,952	8,500,183	674,077	1,212,663	362,311	237,177	34,000	34,000
	4,848,602	9,541,405	6,973,906	9,531,263	48,237,949	31,653,529	894,000	313,000

[1] Figures that may not be shown separately are combined as "Undistributed."

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1946, by States and uses—Continued

State	Sand—Continued							
	Paving				Grinding and polishing [2]		Fire or furnace	
	Commercial		Government-and-contractor					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	387,597	$220,239	86,624	$27,351	(1)	(1)	(1)	(1)
Alaska			(1)	(1)				
Arizona	136,802	121,991	2,953	2,559				
Arkansas	406,940	324,798	(1)	(1)				
California	3,615,049	2,246,872	630,905	235,009	(1)	(1)	200	$260
Colorado	55,892	52,985	53,161	22,373	(1)	(1)		
Connecticut	255,039	147,584	12,150	2,250	(1)	(1)		
Delaware	54,487	34,479			450	$1,035		
Florida	207,515	108,842	10,000	200	6,000	3,000		
Georgia	261,388	171,332	371	56	22,510	7,545		
Hawaii								
Idaho	3,840	3,405	6,836	1,665				
Illinois	1,368,595	847,086	8,450	2,700	(1)	(1)	(1)	(1)
Indiana	1,386,835	863,688					(1)	(1)
Iowa	357,810	179,221	123,167	34,203	(1)	(1)		
Kansas	791,984	440,887	173,530	92,410	(1)	(1)		
Kentucky	328,526	306,541	200	500				
Louisiana	247,274	210,826	78,600	19,650	332	166		
Maine	(1)	(1)	49,374	15,870				
Maryland	970,941	734,176						
Massachusetts	636,903	360,777	55,397	13,590	336	186		
Michigan	1,398,578	826,869	292,642	112,122	134,107	43,980		
Minnesota	605,618	278,713	21,666	7,033	140	75		
Mississippi	275,092	165,963	10,800	640				
Missouri	531,360	318,054	4,193	2,292	(1)	(1)		
Montana	8,500	6,981						
Nebraska	157,488	87,751	695	26	(1)	(1)		
Nevada					(1)	(1)		
New Hampshire	(1)	(1)	363,347	37,218				
New Jersey	797,957	485,898	1,188	141	52,942	148,777	45,428	61,602
New Mexico	(1)	(1)	(1)	(1)	(1)	(1)		
New York	1,552,558	1,103,645	143,302	47,807	2,508	2,508	(1)	(1)
North Carolina	339,633	164,972	1,394,882	563,975	(1)	(1)		
North Dakota	59,858	52,376						
Ohio	1,406,137	994,270	4,023	667	(1)	(1)	(1)	(1)
Oklahoma	340,303	163,468						
Oregon	174,149	186,607	710	263	(1)	(1)		
Pennsylvania	1,417,037	1,309,232			(1)	(1)	42,127	66,172
Puerto Rico			(1)	(1)				
Rhode Island	(1)	(1)	22,984	3,736				
South Carolina	(1)	(1)	8,892	2,474	(1)	(1)		
South Dakota	109,655	73,123	103,475	62,325				
Tennessee	393,914	388,168			(1)	(1)		
Texas	844,290	651,647	39,620	8,613	(1)	(1)		
Utah	100,956	52,514						
Vermont	(1)	(1)	2,765	502	39,924	14,787		
Virginia	809,251	661,447	314,942	67,634	(1)	(1)		
Washington	288,717	180,513	51,959	29,149	(1)	(1)		
West Virginia	401,273	394,118	535	467	(1)	(1)		
Wisconsin	515,512	302,115	648,686	185,973	(1)	(1)		
Wyoming	6,283	6,233	9,912	3,671				
Undistributed [1]	352,508	143,486	19,000	22,000	647,640	1,157,895	161,111	205,609
	24,360,044	16,373,892	4,752,000	1,629,000	906,889	1,379,954	248,866	333,643

[1] Figures that may not be shown separately are combined as "Undistributed."
[2] Includes 292,899 tons of blast sand valued at $736,819.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1946, by States and uses—Continued

State	Sand—Continued							
	Engine		Filter		Railroad ballast [3]		Other [4]	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(1)	(1)					8,000	$13,000
Alaska								
Arizona	8,459	$8,459					6,000	1,250
Arkansas	(1)	(1)			(1)	(1)	(1)	(1)
California	(1)	(1)	1,662	$13,296	14,393	$7,090	47,937	192,896
Colorado	(1)	(1)			15,856	1,359	2,816	1,564
Connecticut	(1)	(1)	15,402	12,288			22,092	9,086
Delaware	63,150	27,154					250	250
Florida	(1)	(1)	(1)	(1)	4,323	889		
Georgia	46,613	12,122					78,398	93,243
Hawaii								
Idaho	(1)	(1)					(1)	(1)
Illinois	176,681	103,099	(1)	(1)	163,384	57,722	115,458	160,638
Indiana	169,497	66,671			22,850	6,795	(1)	(1)
Iowa	54,511	41,334	(1)	(1)	(1)	(1)	128,236	59,054
Kansas	121,280	83,141	(1)	(1)	85,481	19,369	7,421	3,776
Kentucky	(2)	(1)					431	216
Louisiana	11,674	5,757			(1)	(1)	1,620	1,200
Maine	(1)	(1)					(1)	(1)
Maryland	(1)	(1)						
Massachusetts	51,564	18,774	13,098	14,077			55,931	24,517
Michigan	1,440	980			15,427	5,283	(1)	(1)
Minnesota	49,958	18,241			(1)	(1)	47,548	16,317
Mississippi	8,652	4,403						
Missouri	46,093	25,154	(1)	(1)	83,318	27,005	65,540	117,443
Montana							(1)	(1)
Nebraska	(1)	(1)			10,010	2,830	37,361	8,446
Nevada							(1)	(1)
New Hampshire			(1)	(1)			(1)	(1)
New Jersey	46,675	22,288	49,118	122,316			(1)	(1)
New Mexico	(1)	(1)						
New York	(1)	(1)	(1)	(1)	(1)	(1)	119,690	100,852
North Carolina	(1)	(1)	(1)	(1)			8,000	4,800
North Dakota					(1)	(1)		
Ohio	76,449	66,014	(1)	(1)			151,398	225,604
Oklahoma	53,628	26,777						
Oregon	(1)	(1)	(1)	(1)	13,997	6,323	10,257	6,639
Pennsylvania	354,795	406,458	7,142	21,426	(1)	(1)	205,445	308,195
Puerto Rico								
Rhode Island								
South Carolina	(1)	(1)	(1)	(1)	(1)	(1)	34,473	36,624
South Dakota					(1)	(1)		
Tennessee	(1)	(1)					(1)	(1)
Texas	76,159	39,299	(1)	(1)	(1)	(1)	31,408	29,822
Utah	(1)	(1)	1,000	505			(1)	(1)
Vermont	5,986	2,673						
Virginia	124,020	62,010					64,020	49,805
Washington	(1)	(1)					8,861	6,410
West Virginia	382,723	409,626					(1)	(1)
Wisconsin	(1)	(1)	(1)	(1)	7,698	6,233	9,304	10,020
Wyoming					3,920	700		
Undistributed [1]	867,125	474,345	70,089	101,083	274,227	120,491	280,725	266,254
	2,797,132	1,924,779	157,511	284,991	714,884	262,089	1,548,620	1,747,921

[1] Figures that may not be shown separately are combined as "Undistributed."
[3] Includes 83,422 tons of ballast sand valued at $10,562, produced by railroads for their own use.
[4] Includes 164,061 tons of sand valued at $30,658, used by railroads for fills and similar purposes.

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1946, by States and uses—Continued

State	Gravel							
	Building				Paving			
	Commercial		Government-and-contractor		Commercial		Government-and-contractor	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	811,698	$639,626			623,256	$463,379	201,684	$22,886
Alaska			(1)	(1)	(1)	(1)	(1)	(1)
Arizona	262,041	298,216	12,581	$16,800	122,075	99,809	316,569	201,773
Arkansas	450,853	417,898			277,460	240,443	(1)	(1)
California	6,925,004	5,006,495	166,714	71,506	4,316,799	3,252,454	2,766,856	1,514,608
Colorado	(1)	(1)	74,455	74,432	118,081	101,258	1,368,957	934,379
Connecticut	380,365	285,158			230,355	185,194	48,600	18,000
Delaware	11,129	13,355			(1)	(1)		
Florida	471,726	566,757			33,500	30,125		
Georgia							70	10
Hawaii			(1)	(1)				
Idaho	117,876	98,814	31,847	1,853	464,816	446,823	1,182,452	852,049
Illinois	3,168,656	1,912,228			3,806,900	2,075,608	1,608,426	885,579
Indiana	1,287,366	1,047,795	8,987	6,755	2,994,748	1,949,733	350,446	160,018
Iowa	551,209	529,364	8,100	18,000	2,121,329	839,571	3,225,111	523,929
Kansas	166,083	105,418	88,048	2,400	856,106	577,569	823,999	286,250
Kentucky	443,028	415,715	386,401	206,558	220,617	214,550	31,350	24,175
Louisiana	857,483	898,179			1,266,405	1,349,478	58,950	29,500
Maine	110,663	95,269	5,561	4,010	166,583	97,748	2,259,275	624,357
Maryland	634,209	770,076			1,177,914	1,371,145	416,862	37,315
Massachusetts	974,799	920,279	1,280	1,600	931,363	448,929	349,231	33,704
Michigan	2,165,657	1,420,038	134,232	23,107	4,244,216	2,603,103	3,331,390	1,545,936
Minnesota	853,804	813,585	243,028	111,074	901,914	581,035	5,690,253	496,527
Mississippi	564,623	369,480	192,578	137,780	535,254	430,975	467,400	138,500
Missouri	898,113	694,512			935,602	666,579	476,905	199,820
Montana	106,697	117,518			(1)	(1)	1,381,027	625,692
Nebraska	1,175,697	580,025	10,800	4,000	1,699,633	817,859	436,527	268,535
Nevada	15,300	5,240					116,799	40,069
New Hampshire	(1)	(1)			(1)	(1)	1,071,533	101,571
New Jersey	470,139	481,615			343,171	242,619	952	111
New Mexico	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
New York	2,064,248	1,792,383	20,896	2,173	1,929,184	1,661,776	879,815	156,591
North Carolina	465,258	615,545			703,294	815,098	406,677	335,776
North Dakota	116,044	107,055	92,610	34,780	84,261	68,672	1,494,588	215,767
Ohio	2,111,018	1,619,021	17,038	3,407	3,525,630	2,566,327	545,270	169,962
Oklahoma	(1)	(1)			(1)	(1)	364,670	25,478
Oregon	950,093	823,757	46,200	29,000	2,025,899	1,736,624	888,185	754,074
Pennsylvania	2,504,223	2,267,923			1,358,347	1,210,691	506,319	54,954
Puerto Rico			(1)	(1)			(1)	(1)
Rhode Island	(1)	(1)			(1)	(1)	18,675	4,750
South Carolina							17,784	4,950
South Dakota	38,825	27,228	111,676	22,766	134,134	60,989	2,431,243	1,164,167
Tennessee	748,220	814,160	198,278	122,004	704,738	491,758	446,532	165,081
Texas	2,565,123	2,500,142	4,436	5,301	2,077,867	1,950,974	1,095,536	337,634
Utah	327,335	184,594	53,428	19,894	231,944	179,238	570,358	351,960
Vermont	6,540	3,661			(1)	(1)	198,795	130,346
Virginia	638,688	890,930	6,380	245	1,018,196	1,197,003	1,246,962	181,010
Washington	1,559,061	954,270	282,171	218,539	1,188,023	948,799	2,573,889	1,292,172
West Virginia	371,044	353,472			540,717	526,756	221,449	112,859
Wisconsin	1,321,914	805,052	512,883	231,879	2,115,530	1,112,441	6,975,631	2,411,143
Wyoming	34,927	47,748	4,424	7,227	137,084	121,874	1,160,929	577,582
Undistributed [1]	727,736	649,226	37,000	39,000	731,065	590,128	3,616,000	1,920,000
	40,424,515	32,958,822	2,752,000	1,416,000	46,894,010	34,325,134	53,641,000	19,932,000

[1] Figures that may not be shown separately are combined as "Undistributed."

Sand and gravel sold or used by commercial and Government-and-contractor producers in the United States in 1946, by States and uses—Continued

State	Gravel—Continued				Sand and gravel			
	Railroad ballast [5]		Other [6]		Total commercial		Total Government-and-contractor	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(1)	(1)	(1)	(1)	2,634,730	$1,887,287	288,510	$50,289
Alaska					(1)	(1)	(1)	(1)
Arizona	(1)	(1)	(1)	(1)	756,188	742,715	342,603	231,632
Arkansas	307,460	$161,566	22,518	$9,899	2,203,647	1,821,423	(1)	(1)
California	335,728	163,780	287,607	204,053	23,594,131	16,544,164	3,626,718	1,852,296
Colorado	6,946	1,628	14,457	11,988	981,924	712,266	1,551,022	1,084,129
Connecticut	9,315	3,750	126,809	88,078	1,687,702	1,167,574	511,952	54,265
Delaware					187,229	123,532		
Florida	10,000	8,500	(1)	(1)	1,524,667	1,320,619	10,000	200
Georgia					892,849	523,036	441	66
Hawaii							(1)	(1)
Idaho	150,279	65,906			847,372	715,501	1,235,502	856,587
Illinois	1,061,038	412,298	37,310	18,646	15,154,366	10,570,690	1,616,876	888,279
Indiana	700,650	379,979	49,515	35,473	8,390,134	5,488,774	362,133	167,273
Iowa	185,161	72,103	42,584	75,490	4,556,467	2,479,443	3,382,105	580,349
Kansas	(1)	(1)	39,067	40,200	3,352,972	2,124,072	1,090,114	381,750
Kentucky			(1)	(1)	1,745,728	1,570,684	418,006	231,379
Louisiana	94,543	62,280	(1)	(1)	3,247,547	3,031,065	137,550	49,150
Maine	(1)	(1)	11,481	3,429	518,652	280,294	2,315,708	645,014
Maryland			(1)	(1)	3,584,209	3,682,788	416,862	37,315
Massachusetts	83,541	34,060	(1)	(1)	4,228,937	2,856,150	412,748	53,634
Michigan	432,332	271,895	(1)	(1)	11,829,737	7,258,482	3,763,719	1,681,487
Minnesota	683,412	215,445	401,337	96,250	4,841,003	2,589,044	5,973,632	632,390
Mississippi	150,382	59,606	10,813	7,690	1,948,515	1,256,711	670,778	276,920
Missouri	188,739	116,430	(1)	(1)	4,642,306	3,860,836	494,598	209,612
Montana	500,437	211,120	42,311	10,519	1,047,654	676,175	1,381,027	625,692
Nebraska			(1)	(1)	3,517,536	1,688,976	452,275	273,584
Nevada	318,934	224,076			603,707	904,263	116,799	40,069
New Hampshire					(1)	(1)	1,434,880	138,789
New Jersey	(1)	(1)	26,030	39,412	5,121,184	5,403,954	2,140	252
New Mexico	(1)	(1)			349,688	278,442	(1)	(1)
New York	20,281	12,169	177,022	160,407	11,035,047	8,700,459	1,044,202	206,641
North Carolina	(1)	(1)			2,412,236	2,033,960	1,801,559	899,751
North Dakota	356,298	196,463	35,737	6,307	714,796	475,675	1,589,898	250,747
Ohio	818,891	437,234	266,161	417,844	12,699,473	10,931,536	566,601	174,116
Oklahoma	24,000	12,000			1,212,468	921,805	364,670	25,478
Oregon	606,232	377,354	34,109	11,065	4,469,961	3,781,659	949,222	797,013
Pennsylvania	(1)	(1)	32,128	39,727	10,266,894	10,929,376	506,319	54,954
Puerto Rico							(1)	(1)
Rhode Island					(1)	(1)	41,659	8,486
South Carolina					497,595	207,540	26,676	7,424
South Dakota	189,549	67,192	(1)	(1)	568,082	288,194	2,647,526	1,249,628
Tennessee	175,000	114,750	678	644	3,291,210	3,332,574	720,381	300,029
Texas	1,938,700	936,966	3,862	6,229	10,043,604	7,730,802	1,145,245	355,295
Utah	(1)	(1)	(1)	(1)	1,021,632	612,751	631,378	379,332
Vermont	11,741	16,634	4,723	3,268	182,016	110,441	201,560	130,848
Virginia	333,016	487,629	(1)	(1)	3,769,426	4,066,734	1,570,946	252,391
Washington	385,032	166,940	39,189	9,522	4,593,833	3,008,712	2,963,874	1,599,680
West Virginia	(1)	(1)	(1)	(1)	3,235,388	4,404,999	221,984	113,326
Wisconsin	558,259	163,209	(1)	(1)	6,676,579	3,969,327	8,152,134	2,833,501
Wyoming	585,060	321,619	36,936	2,198	827,137	535,353	1,178,814	594,245
Undistributed [1]	789,004	566,552	227,294	139,869	584,408	495,845	3,706,000	2,015,000
	12,009,960	6,341,133	1,969,678	1,438,147	192,092,566	148,096,702	62,039,000	23,290,000

[1] Figures that may not be shown separately are combined as "Undistributed."
[5] Includes 4,077,115 tons of ballast gravel valued at $1,640,726, produced by railroads for their own use.
[6] Includes 637,462 tons of gravel valued at $107,938, used by railroads for fills and similar purposes.

Government-and-Contractor Production.—As shown in the accompanying chart and tables, the output of sand and gravel from noncommercial or Government-and-contractor operations in 1946 accounted for 24 percent of the total tonnage, compared with 22 percent

in 1945. The value of this tonnage in 1946, as in 1945, represented 14 percent of the total for the industry. The increase in quantity is accounted for entirely by gravel and is attributed largely to the expansion of the Government program to improve existing roads and build new highways.

States reported 50 percent of the total in 1946, counties 42, municipalities 2, and other agencies 6.

In 1946 contractors furnished 39 percent of the Government-and-contractor tonnage, compared with 32 percent in 1945. The average value decreased 4 cents per ton in 1946.

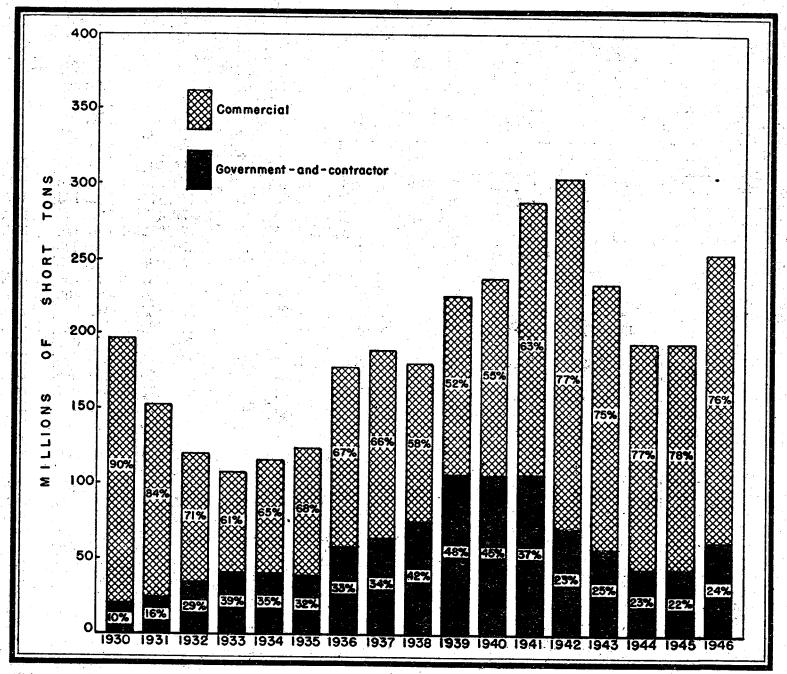

FIGURE 2.—Sand and gravel sold or used in the United States by commercial and Government-and-contractor producers, 1930–46.

Sand and gravel sold or used by Government-and-contractor producers in the United States, 1942–46, by uses

Year	Sand				Gravel				Total Government-and-contractor sand and gravel	
	Building		Paving		Building		Paving			
	Short tons	Value (dollars)	Short tons	Value (dollars)	Short tons	Value (dollars)	Short tons	Value (dollars)	Short tons	Value (dollars)
1942	3,482,000	2,018,000	5,089,000	2,109,000	8,022,000	3,942,000	54,806,000	21,004,000	71,399,000	29,073,000
1943	3,187,000	1,757,000	4,584,000	2,267,000	4,106,000	2,803,000	45,718,000	18,064,000	57,595,000	24,891,000
1944	856,000	474,000	4,592,000	1,431,000	2,663,000	1,626,000	36,039,000	12,837,000	44,150,000	16,368,000
1945	1,018,000	428,000	5,631,000	1,998,000	2,145,000	1,225,000	34,592,000	14,764,000	43,386,000	18,415,000
1946	894,000	313,000	4,752,000	1,629,000	2,752,000	1,416,000	53,641,000	19,932,000	62,039,000	23,290,000

Sand and gravel sold or used by Government-and-contractor producers in the United States, 1943–46, by type of producer

Type of producer	1943		1944		1945		1946	
	Short tons	Average value per ton	Short tons	Average value per ton	Short tons	Average value per ton	Short tons	Average value per ton
Construction and maintenance crews	25,348,000	$0.31	27,889,000	$0.29	29,353,000	$0.31	37,614,000	$0.32
Contractors	32,247,000	.53	16,261,000	.50	14,033,000	.67	24,425,000	.46
	57,595,000	.43	44,150,000	.37	43,386,000	.42	62,039,000	.38
States	18,076,000	.42	18,775,000	.40	15,944,000	.44	30,812,000	.40
Counties	14,504,000	.27	18,421,000	.27	19,126,000	.28	26,005,000	.31
Municipalities	1,191,000	.32	1,227,000	.37	1,155,000	.30	1,402,000	.41
Other agencies	23,824,000	.54	5,727,000	.59	7,161,000	.78	3,820,000	.63
	57,595,000	.43	44,150,000	.37	43,386,000	.42	62,039,000	.38

DEGREE OF PREPARATION

The bulk of the sand and gravel shipped by commercial plants is prepared material, whereas most of the output of Government-and-contractor operations is unprepared material. The accompanying table shows this relationship in the past 2 years. Prepared sand and gravel accounted for 73 percent of the total production in 1946, compared to 71 percent in 1945. The increase is attributed to commercial plants, which reported 91 percent of their production prepared, an increase of 6 percent over that reported in 1945, whereas the proportion of prepared material produced by Government-and-contractors remained the same as in the previous year.

Sand and gravel (prepared or unprepared) sold or used by producers in the United States, 1945–46, by commercial and Government-and-contractor operations

	1945			1946		
	Quantity		Average value per ton	Quantity		Average value per ton
	Short tons	Percent		Short tons	Percent	
Commercial operations:						
Prepared	129,731,535	85	$0.77	174,195,542	91	$0.80
Unprepared	22,406,763	15	.46	17,897,024	9	.50
	152,138,298	100	.73	192,092,566	100	.77
Government-and-contractor operations:						
Prepared	8,434,000	19	.85	11,483,000	19	.70
Unprepared	34,952,000	81	.32	50,556,000	81	.30
	43,386,000	100	.42	62,039,000	100	.38
Grand total	195,524,000		.66	254,131,000		.67

SIZE OF PLANTS

The average plant output of commercial operators, excepting railroad plants, reached 88,000 short tons in 1946, an increase of 29 percent over the 68,000 reported for 1945. Plants producing between 100,000 and 200,000 tons in 1946 accounted for 21 percent of the total output, which represents the largest quantity produced by one group.

Plants producing over 500,000 tons increased from 28 to 48 and supplied 22 percent of the total tonnage. The 50,000- to 100,000-ton group showed the greatest expansion in numbers—from 328 to 398. Details of output, by size groups, are shown in the accompanying table.

Comparison of number and production of commercial sand and gravel plants in the United States, 1945–46, by size groups[1]

Size group, in short tons	1945				1946			
	Plants[2]		Production		Plants[2]		Production	
	Number	Percent of total	Short tons	Percent of total	Number	Percent of total	Short tons	Percent of total
Less than 25,000	1,001	47.6	9,345,000	6.6	838	39.5	7,601,000	4.0
25,000 to less than 50,000	370	17.6	13,394,000	9.4	365	17.2	13,254,000	7.1
50,000 to less than 100,000	328	15.6	23,219,000	16.3	398	18.8	28,196,000	15.1
100,000 to less than 200,000	238	11.3	33,590,000	23.6	277	13.1	39,424,000	21.1
200,000 to less than 300,000	78	3.7	19,089,000	13.4	115	5.4	27,675,000	14.8
300,000 to less than 400,000	44	2.1	15,039,000	10.6	52	2.4	18,019,000	9.6
400,000 to less than 500,000	16	.8	7,023,000	4.9	28	1.3	12,451,000	6.6
500,000 to less than 600,000	9	.5	4,731,000	3.3	16	.8	8,620,000	4.6
600,000 to less than 700,000	6	.3	3,909,000	2.7	9	.4	5,927,000	3.2
700,000 to less than 800,000	3	.1	2,206,000	1.5	2	.1	1,468,000	.8
800,000 to less than 900,000	3	.1	2,520,000	1.8	7	.3	6,119,000	3.3
900,000 to less than 1,000,000	3	.1	2,800,000	2.0	2	.1	1,907,000	1.0
1,000,000 and over	4	.2	5,604,000	3.9	12	.6	16,469,000	8.8
	2,103	100.0	142,469,000	100.0	2,121	100.0	187,130,000	100.0

[1] Plants operated by or for States, counties, municipalities and other Government agencies are not included; also not included are approximately 165 railroad plants with an output of 9,669,000 tons of sand and gravel in 1945 and 133 plants with an output of 4,962,000 tons in 1946.

[2] Includes a few companies operating more than 1 plant but not submitting separate returns for individual plants.

METHOD OF TRANSPORTATION

Truck transportation in 1946, as in the previous year, dominated the industry, accounting for 51 percent of shipments from commercial plants. Railroads carried most of the shipments handled by other methods. Although the quantity shipped by water is small, this method is dominant in some areas. As shown in the accompanying table, the percentage moved by truck becomes even greater when Government-and-contractor output is added. A part of the increase in truck transportation in 1946 was attributed to the shortage of freight cars.

Sand and gravel sold or used by commercial producers in the United States, 1945–46, by methods of transportation [1]

Method of transportation	1945		1946	
	Short tons	Percent of total reported	Short tons	Percent of total reported
Truck	61,439,488	43.5	91,741,944	51.1
Rail	69,456,386	49.2	71,615,794	39.9
Waterway	10,389,771	7.3	16,231,812	9.0
Total reported	141,285,645	100.0	179,589,550	100.0
Percent of total commercial production covered		92.9		93.5

[1] For practical purposes, the entire output of Government-and-contractor operations commonly is moved by truck. Including Government-and-contractor production, sand and gravel moved approximately as follows—1945: Truck 57 percent, rail 37 percent, and waterway 6 percent; 1946: truck 64 percent, rail 29 percent, and waterway 7 percent.

CONSUMPTION TRENDS

Sand and Gravel for Construction.—The demand for sand and gravel by the construction industry in 1946, as measured by shipments from commercial plants, showed a sharp upturn. Building sand reached a peak of 48,237,949 tons, a figure 2,202,248 tons above the previous record year of 1942, and the combined quantity of building and paving sand consumed in 1946 was only 9 percent below that reported in 1942. Although a large number of construction contracts in 1946 were not completed and thus are carry-overs into 1947, many of them proceeded through the foundation stage, where the largest quantities of sand and gravel are consumed. Highway and building construction are expected to keep the demand for sand and gravel at a high level for a number of years.

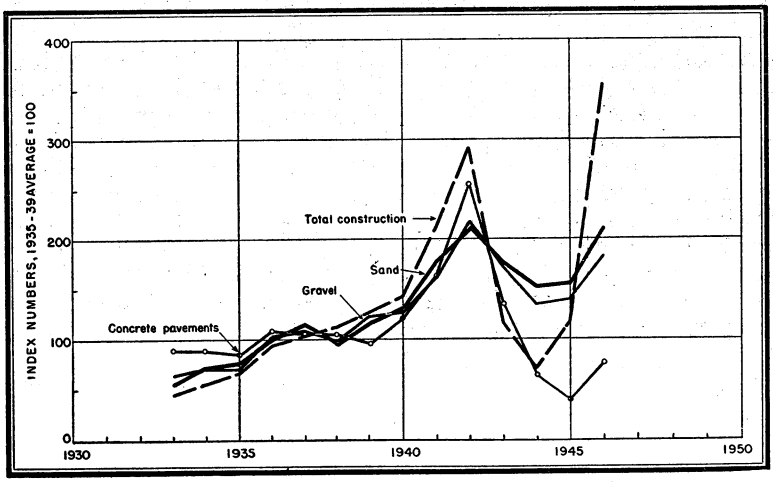

FIGURE 3.—Value of sand and gravel production, compared with total construction (contract awards, value) and concrete pavements (contract awards, thousands of square yards), in the United States, 1933–46. Data on construction and concrete pavements are from the Bureau of Foreign and Domestic Commerce.

Industrial Sands.—Although the output of the industrial sands in 1946 varied little from the previous years' totals, a slight increase is discernible. Industrial production is expected to continue at a high level for a number of years, and it is believed that the trend in the consumption of these sands will continue upward.

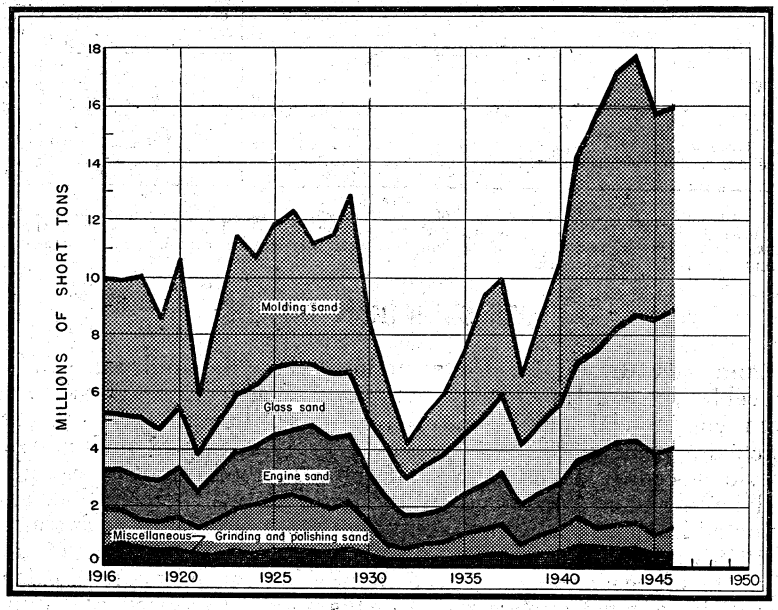

FIGURE 4.—Production of industrial sands in the United States, 1916–46.

EMPLOYMENT AND PRODUCTIVITY

The shortage of manpower available to the sand and gravel industry in 1945 eased somewhat during 1946, as total employment in the industry is believed to have averaged somewhat over 22,000 men. As shown in the following table, the number of days worked and the average production per man per shift was higher in 1946 than in any other year of the 1940–46 period. The accompanying table showing a detailed breakdown of employment and production, by regions, of all commercial plants (except those operated by railroads) indicate that the Pennsylvania-New Jersey-Delaware region employed the largest number of men, but the highest production per man per hour and shift was reported from the Nebraska-Iowa region.

Employment in the commercial sand and gravel industry and average output per man in the United States, 1940–46 [1]

Year	Employment					Production (short tons)			Percent of commercial industry represented
	Average number of men	Time employed				Commercial sand and gravel	Average per man		
		Average number of days	Total man-shifts	Man-hours			Per shift	Per hour	
				Average per man per day	Total				
1940	16,595	217	3,596,886	8.4	30,263,744	101,143,305	28.1	3.3	77.1
1941	19,909	228	4,530,488	8.6	38,978,128	144,594,925	31.9	3.7	79.6
1942	25,061	227	5,679,695	8.9	50,694,303	183,255,772	32.3	3.6	78.7
1943	20,308	234	4,743,721	8.9	42,041,878	138,113,786	29.1	3.3	78.3
1944	17,777	228	4,055,192	9.0	36,584,540	120,968,395	29.8	3.3	80.3
1945	16,528	233	3,857,671	8.7	33,745,368	116,632,047	30.2	3.5	76.7
1946	18,400	240	4,408,376	8.8	39,001,584	159,203,204	36.1	4.1	82.9

[1] Excludes plants operated by or directly for States, counties, municipalities, and other Government agencies.

Employment in the commercial sand and gravel industry and average output per man in the United States, 1945–46, by regions [1]

Region	Employment					Production (short tons)			Percent of commercial industry represented
	Average number of men	Time employed				Commercial sand and gravel	Average per man		
		Average number of days	Total man-shifts	Man-hours			Per shift	Per hour	
				Average per man per day	Total				
1945									
Maine, New Hampshire, Vermont, Rhode Island, Massachusetts, and Connecticut	595	203	120,814	8.7	1,045,435	4,211,648	34.9	4.0	89.2
New York	870	193	167,673	8.2	1,382,469	5,474,550	32.7	4.0	78.7
Pennsylvania, New Jersey, and Delaware	1,957	267	522,127	8.5	4,441,397	11,104,018	21.3	2.5	98.6
West Virginia, Virginia, Maryland, and District of Columbia	1,024	281	287,315	8.8	2,540,562	4,911,236	17.1	1.9	65.3
South Carolina, Georgia, Alabama, Florida, and Mississippi	703	263	185,105	9.1	1,678,303	5,044,553	27.3	3.0	87.5
North Carolina, Kentucky, and Tennessee	925	251	232,552	9.4	2,195,201	4,301,116	18.5	2.0	91.2
Arkansas, Louisiana, and Texas	1,515	256	388,195	9.4	3,644,615	9,815,156	25.3	2.7	67.9
Ohio	1,345	211	284,102	8.4	2,387,009	6,429,464	22.6	2.7	70.5
Illinois and Indiana	1,599	233	372,770	8.4	3,120,323	15,249,499	40.9	4.9	82.3
Michigan and Wisconsin	1,409	205	289,362	9.1	2,633,534	11,741,367	40.6	4.5	77.0
North Dakota, South Dakota, and Minnesota	387	159	61,658	9.0	555,036	2,500,690	40.6	4.5	39.4
Nebraska and Iowa	512	166	85,102	9.4	800,088	3,334,550	39.2	4.2	49.6
Kansas, Missouri, and Oklahoma	721	238	171,356	8.9	1,529,105	5,333,891	31.1	3.5	85.1
Wyoming, Colorado, New Mexico, Utah, and Arizona	362	210	76,165	8.3	630,618	2,627,280	34.5	4.2	68.3

See footnote at end of table.

Employment in the commercial sand and gravel industry and average output per man in the United States, 1945–46, by regions[1]—Continued

Region	Employment					Production (short tons)			Percent of commercial industry represented
	Average number of men	Time employed		Man-hours		Commercial sand and gravel	Average per man		
		Average number of days	Total man-shifts	Average per man per day	Total		Per shift	Per hour	
1945—Continued									
California and Nevada	1,671	263	439,139	8.5	3,727,354	17,477,680	39.8	4.7	87.2
Montana, Washington, Oregon, and Idaho	933	187	174,236	8.2	1,434,319	7,075,349	40.6	4.9	66.8
Total United States	16,528	233	3,857,671	8.7	33,745,368	116,632,047	30.2	3.5	76.7
1946									
Maine, New Hampshire, Vermont, Rhode Island, Massachusetts, and Connecticut	720	210	151,286	8.7	1,313,342	6,580,168	43.5	5.0	91.5
New York	960	229	220,027	8.4	1,851,017	7,605,437	34.6	4.1	68.9
Pennsylvania, New Jersey, and Delaware	1,982	257	510,145	8.7	4,427,853	14,134,677	27.7	3.2	90.8
West Virginia, Virginia, Maryland, and District of Columbia	1,245	293	364,450	9.3	3,379,318	8,021,096	22.0	2.4	75.7
South Carolina, Georgia, Alabama, Florida, and Mississippi	847	270	228,700	9.1	2,083,409	6,653,672	29.1	3.2	88.7
North Carolina, Kentucky, and Tennessee	972	254	246,837	9.6	2,365,931	6,238,963	25.3	2.6	83.8
Arkansas, Louisiana, and Texas	1,500	255	382,307	9.4	3,594,527	10,578,609	27.7	2.9	68.3
Ohio	1,426	247	352,076	8.4	2,971,247	11,812,498	33.6	4.0	93.0
Illinois and Indiana	1,870	241	450,718	8.7	3,908,023	19,971,150	44.3	5.1	84.8
Michigan and Wisconsin	1,622	188	304,395	9.1	2,781,918	15,211,650	50.0	5.5	82.2
North Dakota, South Dakota, and Minnesota	508	163	82,712	9.1	751,628	4,266,764	51.6	5.7	69.7
Nebraska and Iowa	597	184	110,084	9.7	1,068,010	6,228,509	56.6	5.8	77.1
Kansas, Missouri, and Oklahoma	874	264	230,431	8.6	1,987,666	7,628,024	33.1	3.8	82.8
Wyoming, Colorado, New Mexico, Utah, and Arizona	411	199	81,867	8.2	667,597	3,169,885	38.7	4.7	80.5
California and Nevada	1 878	265	497,686	8.5	4,206,796	22,788 924	45.8	5.4	94.2
Montana, Washington, Oregon, and Idaho	988	197	194,655	8.4	1,643,302	8,313,178	42.7	5.1	75.9
Total United States	18,400	240	4,408,376	8.8	39,001,584	159,203,204	36.1	4.1	82.9

[1] Excludes plants operated by or directly for States, counties, municipalities, and other Government agencies.

PRICES

The average value for all shipments of sand and gravel in 1946 increased only 1.5 percent over the previous years' total. For commercial plants, however, the increase was 5.5 percent, which reflects the continued rise in labor and other production costs. Under Office of Price Administration Order No. 23 of May 3, 1946, maximum prices per cubic yard for sand and gravel in the Utica-Rochester area and the Northville area in Michigan were set at $1.10 to $1.20 for gravel 60/40 at the pit and $2.05 to $2.15 delivered; sand, $0.90 to $1 at the pit and $1.85 to $1.95 delivered; clear pebble, $1.55 to $1.70

at the pit and $2.50 to $2.65 delivered. On June 19, 1946, under Amendment 29 to Office of Price Administration Supplementary Order 129, sand and gravel classified as railroad ballast was released from price control. On November 10, 1946, controls on all classes of sand and gravel were abolished by the Office of Price Administration.

FOREIGN TRADE

Imports of sand and gravel in 1946 were 26 percent greater than in 1945 but represented only 0.14 percent of domestic production. Belgium and Luxembourg furnished virtually all of the glass sand received, and Canada supplied 260,203 tons of the "Other sand." The total gravel imported came from Canada. Exports of sand and gravel are not now classified separately by the United States Department of Commerce, but before 1939, when classified, they ranged from 25,000 to 100,000 tons a year. The accompanying table shows imports for the 1937–46 period.

Sand and gravel imported for consumption in the United States, 1937–46, by classes

Year	Sand				Gravel		Total	
	Glass sand [1]		Other sand [2]					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1937	51,090	$79,112	319,134	$134,430	163,406	$36,193	533,630	$249,735
1938	33,889	68,315	611,468	157,992	55,619	22,902	700,976	249,209
1939	23,690	33,604	192,106	79,272	60,147	8,399	275,943	121,275
1940	4,337	8,722	264,170	90,350	175,558	25,686	444,065	124,758
1941			263,389	105,088	164,175	26,132	427,564	131,220
1942	[3]	5	408,825	297,122	146,116	60,389	554,941	357,516
1943	18	363	296,262	206,145	86,924	63,381	383,204	269,889
1944	15	181	209,255	129,632	67,929	31,208	277,199	161,021
1945	[3]	148	200,280	126,102	78,863	42,015	279,143	168,265
1946	5,006	9,102	262,485	194,830	83,860	25,847	351,351	229,779

[1] Classification reads "Sand containing 95 percent or more silica and not more than 0.6 percent oxide of iron and suitable for manufacture of glass."
[2] Classification reads "Sand, n. s. p. f."
[3] Less than 1 ton.

TECHNOLOGIC DEVELOPMENTS

The sand and gravel industry kept pace with modern machine methods in 1946. Water-jet systems were installed on dredges at several Louisiana plants to increase capacity and to provide steady flow and a greater percentage of solids through the dredge pumps.[1] Two Arizona plants featured pushbutton control of much of the equipment, reducing the manpower required to operate the plant.[2] A new plant in California provides ample headroom under all equipment and structures and paving of the entire plant area, including bin, floors, and driveways.[3] The B. F. Goodrich Rubber Co. announced

[1] Swanson, H. E., Jets Boost Pumping Capacity: Rock Products, vol. 49, No. 9, September 1946, pp. 74–77.
[2] Utley, H. F., New Plants and Improvements Serve to Relieve Shortages in Phoenix Area: Pit and Quarry, vol. 39, No. 1, January 1946, pp. 75–76.
[3] Utley, H. F., Kern Rock Company's Gravel Plant Has Novel Design and Operating Features: Pit and Quarry, vol. 38, No. 11, November 1946, pp. 72–75.

the discovery of a silica product that gives rubber compounds the same qualities achieved through the use of carbon black. The new material, called "fumed silica," produced by burning ethyl silicate, gives rubber compounds additional tear and abrasion resistance and tensile strength without affecting the rubber's color or translucency, as does carbon black. Commercial utilization of the new compound is still sometime away because of its present high cost.[4]

IRON BLAST-FURNACE SLAG

The production of iron blast-furnace slag in 1946 reached a new high of 16,706,792 short tons valued at $14,869,839, a figure 32 percent above the 12,635,868 tons valued at $10,450,852 in 1945. The 1946 output, as reported by the National Slag Association, came from 36 companies operating some 50 plants. Details of the tonnage and value of slag consumed in the various uses are shown in an accompanying table. Screened air-cooled slag, the major product, increased 25 percent over the 1945 figure. The largest increases percentagewise, however, occurred in sales of slag utilized for lightweight aggregate, which reached 773,150 tons, an increase of 230 percent; concrete block, 373,257 tons, 182 percent above the 1945 figure; and mineral wool, 629,782 tons, an increase of 57 percent. These commodities are used in the construction industry and present further evidence of the expansion of the highway and housing programs. Although screened, air-cooled, iron blast-furnace slag is produced in 12 States, most of the production comes from the steel centers in Ohio, Alabama, Pennsylvania, and Illinois. Ohio, as in the previous year, was the largest single producer.

Railroads transport the bulk of the tonnage, trucks account for a substantial quantity, and waterways carry only minor amounts. It is believed that the decrease of 6 percent in the quantity moved by railroads in 1946 was due largely to freight-car shortages.

Screened, air-cooled, iron blast-furnace slag sold or used by producers in the United States, 1945–46, by States

[National Slag Association]

	1945			1946		
	Quantity		Value	Quantity		Value
	Short tons	Percent of total		Short tons	Percent of total	
Alabama	3,417,471	28.9	$2,570,830	3,462,614	24.1	$2,887,268
Ohio	3,857,046	32.6	2,951,418	3,849,789	26.9	3,928,964
Pennsylvania	1,396,733	11.8	1,454,479	2,188,061	15.3	2,320,032
Other States [1]	3,163,214	26.7	3,005,613	4,832,432	33.7	4,114,429
	11,834,464	100.0	9,982,340	14,332,896	100.0	13,250,693

[1] Illinois, New York, Maryland, Michigan, West Virginia, Kentucky, Colorado, Texas, and California.

[4] Chemical Industries: Silica Replaces Carbon for Colored Rubber: vol. 59, No. 1, 1946, p. 90.

Iron blast-furnace slag sold or used by producers in the United States, 1938–45 and 1946 by uses

[National Slag Association]

Use	Air-cooled						Granulated			Lightweight [1]		
	Screened			Unscreened								
	Short tons	Value		Short tons	Value		Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton		Total	Average per ton		Total	Average per ton
1938	6,118,505	$5,600,668	$0.92	1,202,754	$567,224	$0.47	656,807	$78,723	$0.12			
1939	7,108,061	5,870,582	.83	812,220	361,554	.45	1,188,094	122,017	.10			
1940	8,132,396	7,015,616	.86	1,230,832	507,288	.41	989,814	257,737	.26			
1941	12,372,218	10,434,187	.84	797,363	390,082	.49	1,508,685	239,833	.16			
1942	13,591,896	11,832,670	.87	2,073,611	884,178	.43	3,457,211	587,094	.17			
1943	13,736,642	11,714,225	.85	1,364,779	540,465	.40	1,329,215	319,421	.24	76,971	$112,817	$1.47
1944	10,730,613	9,260,257	.86	776,302	303,460	.39	733,255	133,308	.18	165,822	232,508	1.40
1945	11,427,689	9,841,813	.86	406,775	140,527	.35	567,297	132,581	.23	234,107	335,931	1.43
1946												
Aggregate for portland cement concrete	1,462,078	1,326,302	.91							773,150	1,321,685	1.71
Mineral aggregate for bituminous plant mix	1,466,662	1,566,987	1.07									
Road construction in types other than above	6,073,552	5,998,604	.99	286,810	139,600	.49	240,464	48,588	.20			
Airport construction [2]	325,265	349,488	1.07									
Railroad ballast	3,426,351	2,404,998	.70	38,808	14,931	.38						
Mineral wool	629,782	681,518	1.08									
Roofing slag	205,831	283,375	1.38									
Sewage trickling filter media	8,460	9,489	1.12									
Agricultural slag	46,979	52,529	1.12				22,943	16,843	.73			
Cement manufacture							682,027	([3])				
Concrete block	373,257	317,928	.85									
Other uses	314,679	259,475	.82	271,339	56,547	.21	58,355	20,952	.36			
Total 1946	14,332,896	13,250,693	.92	596,957	211,078	.35	1,003,789	[4] 86,383		773,150	1,321,685	1.71

[1] For use in the manufacture of lightweight concrete products.
[2] Excludes concrete and bituminous plant mix.
[3] Data not available.
[4] Excludes value of slag used for cement manufacture.

Slag processors in 1946 reported the recovery of 180,432 short tons of iron from slag, an increase of 14 percent over the 158,186 tons recovered in 1945. In view of the critical shortage of pig iron in 1946 this recovery was welcomed by the iron and steel industry.

A total of 4,571,175 man-hours were expended by 2,023 plant and yard employees of the industry in the production of commercial slag in 1946. This excludes those assigned to administrative and sales activities.

Shipments of iron blast-furnace slag in the United States, 1942–46, by methods of transportation, in percent of total

[National Slag Association]

Method of transportation	1942	1943	1944	1945	1946
Rail	52	56	56	67	61
Truck	47	44	44	33	38
Waterway	1	(1)	(1)	(1)	1

[1] Less than 0.5 percent.

Secondary Metals—Nonferrous

By HERBERT L. CULLEN AND A. J. McDERMID [1]

	PAGE		PAGE
General summary	1065	Secondary nickel	1079
Scope of report	1067	Secondary lead	1081
Secondary aluminum	1068	Secondary tin	1085
Secondary magnesium	1072	Secondary antimony	1088
Secondary copper and brass	1074	Secondary zinc	1089

GENERAL SUMMARY

FIGURES on the recovery of nonferrous secondary metals from purchased scrap in 1946 disclose a slight decline in the rate of production of material from secondary sources, as the various industries endeavored to overcome obstacles in the path of normal operation. Regulation of prices of most of the metals surveyed was ended late in the year; but this factor, together with labor difficulties, contributed to the decline in recovery of secondary metals. There were declines in the tonnage reclaimed for five of the metals surveyed, but recovery of lead, antimony, and nickel increased. In general, the trend indicated in the preceding 2 years, from a preponderance of new scrap consumed to one of old scrap, was continued. This trend was aided

Salient statistics of nonferrous secondary metals recovered in the United States, 1945–46

Metal	From new scrap		From old scrap		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1945						
Aluminum	271,076	$77,473,521	27,311	$7,805,484	298,387	$85,279,005
Antimony	2,097	664,330	15,051	4,768,157	17,148	5,432,487
Copper	[1] 509,421	[1] 120,223,356	[1] 497,095	[1] 117,314,420	1,006,516	237,537,776
Lead	[1] 53,190	[1] 6,808,320	[1] 309,849	[1] 39,660,672	363,039	46,468,992
Magnesium	8,422	3,453,020	825	338,250	9,247	3,791,270
Nickel	4,251	2,975,700	2,232	1,562,400	6,483	4,538,100
Tin	11,156	11,602,240	23,977	24,936,080	35,133	36,538,320
Zinc	[1] 269,178	[1] 46,298,616	[1] 91,266	[1] 15,697,752	360,444	61,996,368
		[1] 269,499,103		[1] 212,083,215		481,582,318
1946						
Aluminum	187,538	53,035,746	90,535	25,603,298	278,073	78,639,044
Antimony	3,010	1,042,062	16,105	5,575,551	19,115	6,617,613
Copper	397,093	114,362,784	406,453	117,058,464	803,546	231,421,248
Lead	48,244	8,104,992	344,543	57,883,224	392,787	65,988,216
Magnesium	3,907	1,601,870	1,210	496,100	5,117	2,097,970
Nickel	5,583	3,927,082	2,665	1,874,561	8,248	5,801,643
Tin	10,119	11,045,900	17,552	19,159,763	27,671	30,205,663
Zinc	223,459	39,775,702	77,223	13,745,694	300,682	53,521,396
		232,896,138		241,396,655		474,292,793

[1] Corrected figure.

by such items as greatly increased recovery from old aircraft scrap but was more naturally the result of a return of industry to normal operating practice; during wartime new scrap is generated in higher proportions than in peacetime, and its consequent use is greater.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

The value of metals recovered in 1946 from both new and old scrap was $474,292,793 compared with $481,582,318 in 1945. This decline was due entirely to the drop in total value of metals recovered from new scrap—from $269,499,103 (corrected figure) in 1945 to $232,896,138 in 1946. The value of metals reclaimed from old scrap registered a gain for the fourth successive year, increasing from $212,083,215 (corrected figure) in 1945 to $241,396,655 in 1946.

Secondary metals recovered as unalloyed metal, in alloys, and in chemical compounds in the United States, 1942–46, in short tons

Metal	1942	1943	1944	1945	1946
Aluminum	196,464	313,961	325,645	298,387	278,073
Antimony	18,200	15,483	15,886	17,148	19,115
Copper	927,755	1,086,047	950,942	1,006,516	803,546
Lead	323,001	342,094	331,416	363,039	392,787
Magnesium	6,238	11,404	14,185	9,247	5,117
Nickel	4,142	6,917	4,321	6,483	8,248
Tin	37,918	37,820	32,589	35,133	27,671
Zinc	330,526	368,488	345,469	360,444	300,682

These figures for the value of secondary metals recovered are calculated on the basis of the replacement of primary metals by secondary; that is, if the plants involved had not been able to use scrap in their operations, they would have had to use primary metals amounting in value to the figures quoted above. However, figures representing the current market value do not present the true worth of scrap-metal recovery to the country. A more far-reaching evaluation is afforded by taking into account the conservation of natural resources accomplished by the reclamation of metal from scrap and waste materials. A number of economic papers have appeared in magazines of the mining and metallurgical trades during the past 2 years concerning the economic mineral position of the United States—are we a "have" or a "have not" nation? Regardless of the resolution of this controversy, the fact remains that the secondary metal industry—represented by scrap-metal dealers, remelters, smelters, refiners, brass mills, foundries, chemical plants, and other manufacturers—is the most powerful force working toward the conservation of our natural resources.

It is regrettable that in ordinary times the utilization of secondary metals is of greater concern from an economic standpoint than from a metallurgical one and that, for this reason, the subject has been given inadequate consideration by technical bodies generally. Only under the stress of war calling for the utilization of all materials to the best advantage is any considerable amount of research done toward solving the problems of producing high-grade alloys and other materials from scrap. However, reasonable progress is made year after year in the improvement, metallurgically, of secondary metals. Much of this progress is accomplished because cost is of prime importance to the secondary smelter. Although quality of product is a necessity in such a highly competitive industry, the secondary smelters' objective is to avoid the comparatively costly procedure of "sweetening" melts with refined metal and alloying ingredients

and to concentrate on producing remelt alloys with compositions as near to those of the scrap materials treated as possible. Being bound by these economic limitations, the production records established by the industry in the past few years are remarkable.

SCOPE OF REPORT

Statistics for 1946 regarding scrap and secondary metals were derived from surveys covering all known consumers of purchased nonferrous scrap metals and a representative group of dealers. Reports on consumption of copper-base scrap, copper-alloy ingot, and refined copper were received from 122 plants classed as remelters, smelters, or refiners and from 2,483 plants classed as brass mills, foundries, wire mills, chemical works, and miscellaneous manufacturers. The large consumers of scrap in the secondary copper, lead, zinc, and aluminum industries were canvassed on a monthly basis by the Bureau of Mines, and additional information was received on annual reports from 1,103 foundries and other manufacturers concerning all types of nonferrous scrap except copper-base scrap. A total of 391 plants was represented in the group classed as remelters, smelters, or refiners. Approximately 1,300 of the 4,200 nonferrous scrap dealers in the United States were canvassed in the monthly dealer survey, and the reported figures were expanded to represent 100-percent coverage. Since this survey was discontinued in March 1947, 1946 was the last full year for dealer statistics.

Definitions of the terms used in this chapter are as follows:

"Secondary metals" are metals or alloys recovered from scrap and residues. The term "secondary" applies only to the source of metal and has no relation to the type of product recovered, either as to degree of purity or impurity or to physical characteristics.

"Purchased scrap" means all scrap that entered any plant in scrap form and includes scrap treated for customers upon a toll basis or conversion agreement and interplant transfers of scrap. Scrap salvaged by railroads from line operations and remelted in their own foundries and that melted by Navy Yard foundries which originated in salvage operations are included in this category, as a definite recovery of secondary metal results from the melting of such scrap.

"Interplant transfers" are those made between separate plants owned or operated by the same parent company but not located on the same ground. A transfer of scrap from a machine shop to a foundry at the same plant location is not an interplant transfer, and such "home scrap" is not included in this report. In some isolated instances where a foundry and a brass mill, or a brass mill and a wire mill, were operated at the same general location, it has been necessary to record scrap transferred from one operation to the other and include its consumption in these surveys.

"New scrap" is defined as the refuse produced during the manufacture of articles for ultimate consumption, including all defective finished or semifinished articles that must be reworked. Typical examples of new scrap are defective castings, clippings, punchings, turnings, borings, skimmings, drosses, and slag.

"Old scrap" is defined as scrap consisting of metal articles that have

been discarded after serving a useful purpose. Typical examples of old scrap are discarded trolley wire, battery plates, railroad-car boxes, fired cartridge cases, automobile crankcases, used pipe, and lithographers' plates.

In addition to these definitions, some explanation needs to be given of the method of compiling in this chapter the tables concerning secondary metal recovered. For example, in the first table of the section on Secondary Aluminum, the amount given as secondary aluminum recovered is the same as that for the recoverable aluminum-alloy content. The latter figure is computed by multiplying the weights of all the different types of scrap used by established average percentages for recovery and composition, whereas the data for secondary aluminum recovered are obtained from the production sections of individual reports. It is obvious that the totals arrived at by these two methods could not be exactly the same without adjustment. In the table for aluminum recovery, the figure for "aluminum recovered in aluminum alloys" is adjusted to make the total the same on both sides of the table. Figures for corresponding tables for the other secondary metals are obtained in similar fashion. The term "aluminum" in the tables covers aluminum alloys, including all constituents recovered from aluminum-base scrap, such as copper, magnesium, zinc, silicon, etc. The copper, zinc, and magnesium recovered from aluminum-base scrap appear again in the tables devoted to those metals, so there is duplication of recovery to this extent.

SECONDARY ALUMINUM

The recovery of secondary aluminum declined for the second year in succession, totaling 278,073 short tons in 1946, valued at $78,639,044. The record year was 1944, when 325,645 tons were recovered. In 1945, recovery was 298,387 tons valued at $85,279,005. Values were calculated on the basis of the average market price of all grades of primary ingot and pig, which was 14.29 cents a pound in 1945 and 14.14 cents in 1946.

Secondary aluminum [1] recovered in the United States, 1945–46, in short tons

Secondary aluminum recovered			Recoverable aluminum-alloy content of scrap		
Form of recovery	1945	1946	Kind of scrap processed	1945	1946
As metal	2,145	2,075	New scrap:		
Aluminum alloys	293,967	274,068	Aluminum-base [2]	270,810	187,172
In brass and bronze	1,162	597	Copper-base	107	115
In zinc-base alloys	267	504	Zinc-base	159	52
In magnesium alloys		266	Magnesium-base		199
In chemical compounds	846	563		271,076	187,538
	298,387	278,073	Old scrap:		
			Aluminum-base [3]	26,712	90,005
			Copper-base	491	169
			Zinc-base	108	336
			Magnesium-base		25
				27,311	90,535
				298,387	278,073

[1] In accordance with common usage, the term "aluminum" covers aluminum alloys, and the figures include all constituents of the alloys recovered from aluminum-base scrap.
[2] Recoverable aluminum content of new aluminum-base scrap was 252,098 tons in 1945 and 174,737 tons in 1946.
[3] Recoverable aluminum content of old aluminum-base scrap was 24,527 tons in 1945 and 82,941 tons in 1946

Although the total recoverable aluminum-alloy content of all scrap treated declined, the recovery from old scrap increased, principally because of greatly increased recovery from aircraft scrap. This boosted the recovery of aluminum from old aluminum-base scrap from 26,712 tons in 1945 to 90,005 tons in 1946. Recovery of aluminum from zinc-base scrap increased threefold on account of increased use of zinc die-cast and die scrap, which contains about 4 percent aluminum.

The over-all decrease in recovery of aluminum from scrap was caused by a falling off in recovery from aluminum-base scrap in wrought products and castings at plants operated by primary producers. Production of secondary aluminum at primary plants declined from 108,705 tons in 1945 to 73,388 tons in 1946, a decrease of more than 32 percent. The figures for the production of secondary aluminum at primary plants represent the secondary metal content of the total production and do not refer to a separate secondary product. Scrap is melted at primary plants with virgin metal and constitutes only a small percentage of the total raw material used. At these plants, which are operated in connection with aluminum rolling mills, home scrap and purchased scrap are used with primary aluminum and added alloying ingredients, such as copper, manganese, and zinc, to make alloys suitable for wrought products or castings. The procedure is such that no method has yet been found for determining the proportions of the secondary recovery to be assigned to castings and to wrought products.

Production of secondary aluminum and aluminum-alloy products in the United States, 1944–46, gross weight, in short tons

	1944	1945	1946
Secondary aluminum ingot: [1]			
Pure aluminum (98.5 percent)	1,151	2,066	2,075
Silicon (max. Cu, 1 percent)	2,885	10,618	15.700
Silicon (Cu, 1 to 2.5 percent)	14,600	14,635	7,268
No. 12 aluminum	19,735	22,674	38,286
Other aluminum-copper (max. Si, 2.5 percent) alloys	9.772	26.360	23.714
Copper-silicon (each over 2.5 percent) alloys	20,744	50,983	67,540
Aluminum-copper- or aluminum-silicon-nickel alloys	11,864	18,208	2,603
Deoxidizing and other destructive uses	48,652	44,175	31,011
Die-casting alloys	22,631	[2]	[2]
Aluminum hardeners	5,961	3,964	2,242
Wrought alloys	21,651	[2]	[2]
"Primary-grade" ingot	17,078	[2]	[2]
Ingot for chemicals, powder, etc	5,638	[2]	[2]
Piston alloys	11,815	[2]	[2]
Miscellaneous (and Mg and Zn alloys)	702	4,743	17,135
	[3] 214,879	198,426	207,574
Secondary aluminum by primary producers [4]	124,108	108,705	73,388
Aluminum powder	[5] 346	[5] 79	
Aluminum-alloy castings (except by primary producers)	1,134	2,555	4,444
Aluminum in chemicals	1,616	846	559

[1] Gross weight of alloys, including copper, silicon, and other added elements; total secondary ingot contained 8,792 tons of primary aluminum in 1944, 6,816 tons in 1945, and 1,025 tons in 1946.
[2] Production for 1945 and 1946 included under other classifications.
[3] Includes 9,089 tons produced on toll.
[4] Combined with primary aluminum for the production of wrought products and castings.
[5] Does not include production measured as ingot for graining, powder, atomizing, or chemical purposes.

Output of remelt aluminum ingot increased from 198,426 tons in 1945 to 207,574 tons in 1946, a gain of approximately 5 percent. Monthly production exhibited a rising trend in the latter half of the

year, reaching a peak of 21,265 tons in October. Production of aluminum-silicon (maximum copper, 1 percent) alloys, No. 12, and aluminum-copper-silicon (each over 2.5 percent) alloys increased appreciably in 1946, but output of deoxidizing ingot declined from 44,175 tons in 1945 to 31,011 in 1946.

Consumption of aluminum-base scrap totaled 344,472 tons in 1946 or 20,796 tons more than in 1945, but the recovery of metal from this kind of scrap was 20,345 tons less. The explanation of this apparent anomaly lies in the fact that a much larger proportion of the scrap consumed in 1946 was aircraft scrap, from which the recovery is comparatively low. The 1946 consumption of the two items most used in 1945—alloy sheet and borings and turnings—was 88,054 and 34,763 tons, respectively, compared with 133,920 and 104,118 tons in 1945. Total consumption of plant scrap, which includes the higher-priced types, was almost a third more in 1945 than in 1946. New scrap consumption would have been greater in 1946 if more had been available from foundries and fabricators—the generators of such scrap. Activities at these plants were hindered during much of the year by strikes and reconversion problems. Plants reporting on the monthly aluminum scrap survey in 1946 comprised 68 aluminum-ingot makers, including 7 naval air stations.

Consumption of purchased aluminum scrap in the United States in 1946, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries				Total scrap used
			Aluminum-rolling mills		Foundries and other manufacturers		
	New scrap	Old scrap	New scrap	Old scrap	New scrap	Old scrap	
Pure clippings, wire, and foil	10,000	272	11,433	-------	776	12	22,493
Castings and forgings	31,320	21,038	3,964	-------	552	1,864	58,738
Alloy sheet	50,257	4,223	33,344	-------	158	72	88,054
Scrap sheet and sheet utensil	-------	3,188	-------	-------	67	256	3,511
Borings and turnings	33,323	-------	1,163	-------	277	-------	34,763
Die castings	-------	-------	-------	-------	765	8	773
Aircraft scrap	-------	55,284	-------	49,611	-------	50	104,945
Miscellaneous aluminum and dross	20,706	7,958	1,873	-------	658	-------	31,195
	145,606	91,963	51,777	49,611	3,253	2,262	344,472

Considerable progress was made during the year in developing improved methods of segregating aluminum scrap by alloy and in technique for treating scrap. Much was learned about the effect of furnace atmosphere on quality of metals; the elimination of oxide inclusions, absorbed gases, and undesirable elements; and the effect of minor elements on the properties of aluminum alloys. St. John [2] stated that many of the elements now severely limited by specifications can be present in reasonable amounts without in any way causing deterioration of the properties of the alloy. It was shown that zinc can be present in amounts far beyond the limitation in some of the specifications. It was also determined that, in some of

[2] St. John, A. E., The Smelting and Refining of Commercial Aluminum Ingot: Daily Metal Reporter, vol. 46, No. 86, May 4, 1946, part II, pp. 1, 13–18.

the alloys, iron and manganese are beneficial to mechanical properties. Birdsall [3] claims that, at Reynolds' Louisville Plant No. 5, the metal reclaimed from aircraft scrap was of such purity that no sweetening was required to make it suitable for use in wrought or cast products. Features of procedure at this plant were use of chlorine gas exclusively and continuously for fluxing, charging of aircraft scrap in large pieces without cutting or segregation, and recovery of over 95 percent of the aluminum content of the scrap.

Stocks of aluminum scrap in the hands of consumers at the end of 1946 totaled 52,386 tons, compared with 37,589 tons at the end of the preceding year. In addition, there were, on December 31, 1946, 3,113 tons of unprepared aircraft scrap at naval air stations and 6,610 tons of aluminum scrap, of which 4,200 tons were aircraft scrap, at the nine storage depots of the War Assets Administration. At five Army airfields there were also large stocks of aircraft scrap, which had been sold to private companies during the year. Some of these companies began dealer transactions which were reported on the dealer survey.

Consumers' stocks of purchased aluminum-base scrap in the United States at end of the year, 1945–46, gross weight, in short tons

Scrap item	On hand—	
	Dec. 31, 1945	Dec. 31, 1946
Castings and forgings	9,904	8,011
Sheet, turnings, clippings, etc.	15,006	25,145
Aircraft scrap	10,551	11,662
Miscellaneous aluminum and dross	2,128	7,568
	37,589	52,386

All of the aluminum-scrap figures derived from the dealer survey for 1946 are a little below those for 1945. Dealers' receipts, from generators and other sources, shipments to consumers, and stocks at the end of the year were 149,541, 151,874, and 53,252 tons, respectively. The corresponding figures for 1945 were 154,726, 155,043, and 55,495 tons.

Secondary aluminum ingot and scrap were not under price control during 1946, having been released from that limitation November 20, 1945. As a result of the strong demand in a free market, the dealers' buying price for cast-aluminum scrap in New York rose gradually from a monthly average of 3.75 cents in January to 7.75 cents in December, the average for the year being 5.24 cents. The average price of new aluminum clippings was 7.94 cents in 1946, an increase of 2.11 cents over the 1945 average of 5.83 cents. The prices for secondary ingot also increased, that for high-grade secondary ingot rising from 13.75 cents in January to 16.46 cents (higher than the quotation for primary aluminum) in December, the average for the year being 14.59 cents. The price for this grade of ingot during most of 1945 was 12.50 cents, the ceiling price.

The price limits set by Surplus Property Administration Regulation 12, below which aluminum scrap in contractor inventories could not

[3] Birdsall, G. W., Reclamation of Aircraft Aluminum: Metal Progress, vol. 50, No. 6, December 1946, pp. 1232-1238.

be sold but would be stored in Government depots, remained in effect with one change; the minimum price for class D scrap—solids mixed with foreign materials—was reduced from 4 cents to 2.5 cents a pound on March 28 by the War Assets Administration. On April 2 the WAA issued Revised Order 1 to SPA Regulation 12, which provided that all agencies file a report to the WAA on all sales of 250,000 pounds or more of aluminum in any form. A report also had to be made of any retention of such a quantity, or any sale of such quantity by a contractor out of contractor inventory.

SECONDARY MAGNESIUM

During 1946 only 5,117 short tons of secondary magnesium (including alloying ingredients) were recovered from scrap, representing a decline of 45 percent from the 9,247 tons reclaimed in 1945. The value of this secondary magnesium was $2,097,970 compared with $3,791,270 for that recovered in 1945, value being computed at 20.50 cents a pound in both years.

Recovery of magnesium from old scrap constituted 24 percent of the total, compared with only 9 percent in 1945. Although the tonnage reclaimed from old magnesium-base scrap was a little less than in the preceding year, recovery from old aluminum-base scrap increased considerably, and that from new magnesium-base scrap experienced a sharp decline. In this respect, consumption of magnesium scrap reached normal distribution during the year, as the quantity of turnings and borings used amounted to only 24 percent of the total compared with 65 percent in 1945 and 89 percent in 1944. These figures graphically illustrate the difference in the generation of scrap in wartime and peacetime production.

As the market for secondary magnesium ingot was practically nonexistent and the supply of scrap was small during the year, secondary smelters produced only 2,063 tons of secondary magnesium-alloy ingot, compared with 7,835 tons in 1945 and 14,419 tons in 1944. However, these smelters reported that production of the 2,063 tons of secondary ingot required blending only 3 tons of primary magnesium and 1 ton of alloying ingredients, in addition to the purchased scrap used, compared with 414 tons of primary magnesium and 168 tons of alloying ingredients used in 1945.

Secondary magnesium recovered in the United States, 1945–46, in short tons

Secondary magnesium recovered			Recoverable magnesium-alloy content of scrap		
Form of recovery	1945	1946	Kind of scrap processed	1945	1946
Magnesium-alloy ingot[1] (gross weight)	7,359	2,506	New scrap: Magnesium-base	8,422	3,907
Magnesium-alloy castings (gross weight)	496	1,145		8,422	3,907
Magnesium-alloy shapes	864	136	Old scrap:		
In aluminum alloys	274	1,218	Magnesium-base	697	632
In zinc alloys	3	4	Aluminum-base	128	578
In other alloys	10	2		825	1,210
Chemical and incendiary uses	241	106			
	9,247	5,117		9,247	5,117

[1] Figures include secondary magnesium incorporated in primary magnesium ingot.

Recovery of secondary magnesium in magnesium-alloy castings was greatly increased, totaling 1,145 short tons in 1946 compared with 496 tons in 1945. In view of the decline in secondary alloy ingot production, the increased consumption of purchased scrap in foundries is significant, as many magnesium foundries have reported in the past that they were unable to use their own home scrap, such as gates and risers, because of contamination of foundry sand by magnesium oxide and the resulting surface defects on castings.

In addition to the tonnage of magnesium recovered from the melting of aluminum-base scrap (principally wrecked aircraft), an increased quantity of magnesium was recovered in aluminum alloys because of the use of magnesium scrap directly for this purpose. A large part of this tonnage was reported by the primary aluminum producers, who find magnesium scrap a suitable means for introducing magnesium into aluminum alloys. Recovery of secondary magnesium in chemical and incendiary uses declined from 241 tons in 1945 to 106 in 1946. Chemical applications included use in fluxing compounds, in the Grignard reaction, and in the production of magnesium nitrate and chloride; and the incendiary uses, which accounted for large tonnages of borings during the war, were in flares and incendiary bombs. Owing to the decreased generation of magnesium turnings and borings, storage of this material did not present the same problem as in the past, when large quantities were disposed of by burning to avoid the fire hazard incident to storage.

Stocks and consumption of magnesium scrap in the United States in 1946, gross weight, in short tons

Scrap item	On hand—		Consumption during 1946
	Dec. 31, 1945	Dec. 31, 1946	
Cast scrap	1,424	3,350	2,601
Solid wrought scrap	625	1,598	1,261
Borings, grindings, drosses, etc.	227	292	1,233
	2,276	5,240	5,095

Dealer buying prices for magnesium scrap were not normally listed in the trade journals in 1946, probably because the greater part of the available tonnage was derived from contract terminations and Government sources. A reliable authority, however, quoted the average buying price at 7 cents a pound for segregated solid scrap and 4.50 to 5 cents a pound for unsegregated solids. The price of class A remelt magnesium ingot was quoted at 15.75 to 16.25 cents a pound (carload lots) until October 23, after which it rose slowly—the quotation being 18 to 18.50 cents at the end of the year.

The magnesium industry made considerable progress during the year in the application of this versatile light metal to production of consumer goods. The weight factor is an important consideration governing its future use in the transportation industry and in many uses where light weight saves labor and transportation costs, such as household appliances, office equipment, furniture, toys, farm equipment, etc. The aircraft industry will, of course, continue to be a

most important consumer. As the normal life of such goods is considerably longer than that of most articles made of magnesium in recent years, it seems certain that the quantity of magnesium scrap returning to smelters and foundries for reuse in the next few years will consist principally of production scrap, and some time will elapse before old magnesium scrap becomes an appreciable factor in nonferrous dealer transactions.

SECONDARY COPPER AND BRASS

The recovery of secondary copper from scrap totaled 803,546 short tons valued at $231,421,248 in 1946, a decline of 20 percent from the 1,006,516 tons valued at $237,537,776 recovered in 1945. Value was computed at 11.8 cents a pound in 1945 and 14.4 cents a pound in 1946, the average prices of deliveries of refined copper at New York in the 2 years, exclusive of bonus payments under the Premium Price Plan.

Recovery of copper from old scrap fell from 497,095 tons (corrected figure) in 1945 to 406,453 tons in 1946. However, recovery from old scrap amounted to approximately 51 percent of the total in 1946 compared with 49 percent in the preceding year. Recovery of copper from new scrap declined from 509,421 tons (corrected figure) in 1945 to 397,093 tons in 1946, as the source of this material was affected by such factors as labor trouble in the brass mills and loss of production caused by readjustment of industry to peacetime manufacturing procedures. Although recovery from new scrap represents, to a certain extent, the recycling of metal already consigned to the pool of metal in use, reclamation of metal from old scrap is regarded as a definite addition to the pool and may be combined with the data for net imports and domestic mine production in any given year to compute the total addition to the Nation's supply of that particular metal.

Secondary copper recovered in the United States, 1945-46, in short tons

Secondary copper recovered			Recoverable copper content of scrap		
Form of recovery	1945	1946	Kind of scrap processed	1945	1946
As unalloyed copper:			New scrap:		
At primary plants	96,662	105,572	Copper-base	[1] 495,407	388,291
At other plants	16,194	31,337	Aluminum-base	13,211	8,123
			Nickel-base	803	678
	112,856	136,909	Zinc-base	----------	1
In brass and bronze	[1] 855,574	630,588		[1] 509,421	397,093
In alloy iron and steel	2,133	1,932			
In aluminum alloys	[1] 16,768	14,434	Old scrap:		
In other alloys	519	491	Copper-base	[1] 495,164	401,791
In chemical compounds	18,666	19,192	Aluminum-base	1,204	3,664
			Nickel-base	503	789
	893,660	666,637	Lead-base	60	104
			Tin-base	164	104
	1,006,516	803,546	Zinc-base	----------	1
				[1] 497,095	406,453
				1,006,516	803,546

[1] Corrected figure.

During 1946, 111,613 tons of refined copper (electrolytic grade) were produced from scrap, a gain of more than 13 percent over the 98,338 tons produced from this source in 1945. In view of the strong

demand for all types of copper and copper-base scrap during the year, this increase may be interpreted to mean that the lower-grade items of copper scrap, which are normally used by the refineries, were being marketed freely, whereas the more desirable grades, which are usually consumed by other industries, were being withheld from the market in anticipation of possible price increases. Total recovery of unalloyed copper from scrap increased 21 percent—from 112,856 tons in 1945 to 136,909 in 1946.

The commercial production of brass and bronze ingot declined for the second straight year, totaling 346,241 short tons (gross weight) in 1946 compared with 378,454 tons in 1945 and 518,261 in 1944. The 346,241 tons of ingot produced contained 282,981 tons of copper, of which 17,029 tons were refined copper and the rest was recovered directly from scrap. Shipments of ingot during the year totaled 353,457 tons, as inventories at producers' plants declined from 23,259 tons (revised figure) at the beginning of the year to 16,043 tons on December 31. Reports were tabulated covering 72 plants classified as brass and bronze-ingot producers in 1946. From their scrap melts 4 brass-ingot makers produced 4,241 tons of brass-mill billets and cakes, which were later rolled into finished products at brass mills.

Analysis and production of secondary copper and copper-alloy products in the United States, 1945–46

Item produced from scrap	Approximate analysis (percent)						Gross weight produced (short tons)	
	Cu	Sn	Pb	Zn	Ni	Al	1945	1946
Refined copper (electrolytic grade)	100						98,338	111,613
Casting copper	99						3,339	4,839
Copper sheet, rod, tubing, etc	99						8,037	17,171
Copper powder	98						2,727	2,982
Copper castings	98						415	304
Total unalloyed copper products							112,856	136,909
Brass and bronze ingots:								
Tin bronze	88	10		2			41,621	20,290
Leaded-tin bronze	88	6	1.5	4.5			37,963	21,703
Leaded red brass	85	5	5	5			128,326	145,999
Leaded semired brass	81	3	7	9			36,162	54,788
High-leaded-tin bronze	80	10	10				39,326	28,651
Do	84	6	8	2			7,221	10,393
Do	75	5	20				4,466	6,674
Leaded yellow brass	66	1	3	30			19,269	24,209
Manganese bronze	62			27		5	41,495	9,802
Aluminum bronze	89					10	3,439	2,328
Nickel silver	58	2	7	18	14		3,704	4,923
Do	65	4	3	5	22			
Low brass	80			20			4,677	2,304
Silicon bronze	92			4			3,060	2,719
Conductor bronze	94	2	2	2			438	867
Hardeners and special alloys	81						7,287	10,591
Total copper-alloy ingots							378,454	346,241
Brass mill billets made by ingot makers							16,653	4,241
Brass and bronze sheet, rod, tubing, etc							[1] 576,115	[1] 389,587
Brass and bronze castings							[2] 142,532	[2] 129,102
Brass powder							659	803
Copper in chemical products (content)							18,666	19,192

[1] Gross weight of secondary brass and bronze in commercial shapes. Includes 398,822 tons of copper, 937 tons of nickel, 4,938 tons of lead, 837 tons of tin, 170,099 tons of zinc, and 482 tons of aluminum in 1945; and 266,859 tons of copper, 1,749 tons of nickel, 3,786 tons of lead, 381 tons of tin, 116,743 tons of zinc, and 69 tons of aluminum in 1946.

[2] Gross weight of secondary metal in brass and bronze castings. Includes 112,768 tons of copper, 158 tons of nickel, 12,917 tons of lead, 8,138 tons of tin, 8,517 tons of zinc, and 34 tons of aluminum in 1945; and 99,959 tons of copper, 112 tons of nickel, 15,415 tons of lead, 6,459 tons of tin, 7,022 tons of zinc, and 135 tons of aluminum in 1946.

An itemization of the tonnage of each type of billets made cannot be published, because individual company operations would be revealed.

Production by brass mills from copper and copper-base scrap declined 30 percent from the 1945 level. The tonnage recovered from scrap in brass and bronze sheet, rod, and tubing dropped from 576,115 tons in 1945 to 389,587 in 1946, although their recovery in the same products made of unalloyed copper increased from 8,037 tons in 1945 to 17,171 in the following year. Brass mills were not required to report their production to the Civilian Production Administration during the first 3 months of the year, when strikes in the copper refineries and brass mills were at a peak. Although exact analysis of the production statistics is difficult for that reason, it is evident that that portion of the total production represented by recovery of metal from scrap was slightly lower in 1946 than during the preceding year. However, reports filed with the Bureau of Mines indicated that, during that part of the first quarter when operations were possible, brass mills operated on a larger percentage of scrap than during the succeeding 9 months because of the shortage of refined copper. Toward the end of the year production by these mills was on a firm basis, that for October being the highest of any peacetime month in the history of the industry.

Recovery of secondary brass and bronze in castings by brass and bronze foundries declined more than 9 percent, from 142,532 tons in 1945 to 129,102 tons in 1946. As in the past, a considerable portion of this tonnage consisted of bronze railroad bearings remelted in railroad foundries and in plants of bearing companies on a toll basis.

Consumption of purchased copper scrap in the United States in 1946, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries				Total scrap used
			Brass mills		Foundries and other manufacturers		
	New scrap	Old scrap	New scrap	Old scrap	New scrap	Old scrap	
No. 1 wire and heavy	33,931	50,864	7,316	1,509	1,840	17,472	112,932
No. 2 wire, mixed heavy, and light	34,065	50,745	10,286	4,022	2,387	7,529	109,034
Composition or red brass	41,202	46,725	-------	-------	19,858	25,073	132,858
Railroad-car boxes	-------	479	-------	-------	-------	50,442	50,921
Yellow brass	23,958	79,413	284,898	6,246	3,955	10,893	409,363
Cartridge cases	272	12,141	-------	51,363	-------	165	63,941
Auto radiators (unsweated)	-------	22,648	-------	-------	-------	128	22,776
Electrotype shells	-------	1,715	-------	-------	-------	-------	1,715
Bronze	4,888	29,113	1,604	761	2,325	8,947	47,638
Nickel silver	704	2,593	9,604	838	35	16	13,790
Low brass	3,811	783	16,921	5,743	477	3,476	31,211
Aluminum bronze	247	738	264	45	39	611	1,944
High-lead brass	-------	524	-------	-------	-------	2,016	2,540
Low-grade scrap and residues	80,777	87,030	-------	-------	417	253	168,477
	223,855	385,511	330,893	70,527	31,333	127,021	1,169,140

The total consumption of purchased copper and brass scrap in 1946 was 1,169,140 short tons, gross weight, a decline of approximately 21 percent from the 1,470,737 tons used in 1945. Brass-ingot makers and refiners decreased their consumption 15 percent to 609,366 tons,

and the use of scrap by brass mills declined 33 percent to 401,420 tons. Both decreases were due mainly to the extreme shortage of the more desirable grades of scrap. The quantity of cartridge cases reported consumed during the year was 63,941 tons. However, an additional tonnage of new deprimed cartridge cases amounting to about half this weight was absorbed by the industry during the year and was probably reported under other scrap classifications.

During all that portion of the year before November 10 the Office of Price Administration strove desperately to maintain ceiling prices unchanged on such items as primary copper, copper and copper-base scrap, brass- and wire-mill products, and brass ingot despite unremitting pressure from industry. Lack of sympathy with OPA policy on the part of industry fostered a shortage of available scrap, since dealers and other holders of the material were loath to sell with possible price increases in view. The artificial conditions created are evidenced by the fact that shipments of copper-base scrap to consumers by scrap-metal dealers rose rapidly after the removal of price controls and in January 1947 reached a record of 68,094 tons, about 35 percent higher than any monthly shipments reported in the previous 5-year period. During the summer of 1946, the shortage of copper was so acute that instances were reported wherein advantage was taken of loopholes in the price regulations to procure refined copper from scrap at whatever price was necessary.

A number of efforts were made by CPA and WAA to market Government-owned copper and brass scrap in such a way as to alleviate civilian shortages and still to fulfill the provisions of the stock-pile act. Order 3 to SPA Regulation 17, effective March 11, authorized sales of Army and Navy copper scrap direct to the trade instead of diverting the surplus to the strategic stock pile, but restricted inventories on all types of copper products to a 45-day supply. It later developed that the quantity of material available fell considerably short of expectations, and the demand for the material was greater than the supply. Consequently, on June 4, Order 3 was revoked upon request of CPA, and Direction 19 to Priorities Regulation 13 was issued by CPA to take its place. Direction 19 placed restrictions on sales of scrap and surplus brass- and wire-mill products, limiting sales of these materials by the WAA to persons who certified their needs to CPA. This automatically channeled copper and copper-base alloy scrap to smelters and reprocessors, except where persons buying for resale certified that they would promptly reoffer the material acquired. On September 24, the CPA issued Direction 22 to PR 13, which provided for the allocation of scrap from Army, Navy, and Maritime Commission sources by CPA, instead of having the material declared surplus to the WAA and distributed by that agency under CPA direction. This direction covered all lots of copper or copper-base alloy scrap that exceeded 10,000 pounds in weight. Direction 22 was amended on December 3 to cover only such items as cartridge-brass ingot and slab, fired-cartridge cases, and gilding-metal mill forms or remelt ingot. At the same time, CPA revoked Direction 19 to PR 13. An additional order was Direction 11 to PR 32, issued by CPA on October 29, which placed certain restrictions on receipts of copper and copper-base-alloy scrap by dealers and brokers.

Ceiling prices on brass and bronze ingot, which were controlled under Maximum Price Regulation 202, were advanced in amounts up to 2.50 cents a pound by Amendment 5 to that regulation on June 3 and an additional 0.25 cent a pound by Amendment 6 on August 27. After removal of price controls on November 10, the brass-ingot industry established prices on the principal grades of ingot, which held until the end of the year, as follows: 85–5–5–5, 20.50 cents a pound; 80–10–10, 23.50 cents; yellow brass, 16.25 cents; and 88–10–2, 24.75 cents. Maximum Price Regulation 20, which controlled the prices of all copper and copper-base scrap other than brass-mill scrap, was also amended on June 3, allowing increases up to 1.75 cents a pound. A further amendment on July 26 provided for variations in the copper content of soft red-brass borings. June 3 was likewise marked by the issuance of advanced prices on brass-mill scrap, by Amendment 10 to Revised Price Schedule 12. On September 20, the OPA announced that no increase in the ceiling prices of copper scrap, copper-base alloy scrap, or brass-mill scrap was planned in the foreseeable future, hoping to aid the flow of these materials toward consumers' plants. After November 10 prices jumped but were finally stabilized by the establishment of buying prices by ingot makers, brass mills, and refiners.

Consumers' stocks of purchased copper-base scrap in the United States at end of year, 1945–46, gross weight in short tons

Scrap item	On hand—	
	Dec. 31, 1945 [1]	Dec. 31, 1946
Unalloyed copper	16,145	23,034
Copper-base alloy	57,104	62,622
Low-grade scrap and residues	37,913	38,813
	111,162	124,469

[1] Revised figures.

Inventories of copper and brass scrap at consumers' plants increased 12 percent, from 111,162 short tons (revised figure) at the beginning of the year to 124,469 tons on December 31, 1946.

Shipments of copper and brass scrap by dealers to consumers during the year totaled 506,494 tons, an increase of 3 percent over the 490,789 tons shipped during the preceding year. There was a noticeable decline in shipments during May, when an early increase in price ceilings was expected, which materialized on June 3. After that date a flurry of sales during June caused shipments in that month to reach the year's highest point. Shipments were normal from July until December, when the removal of price controls caused dealers to begin reducing inventories again. Stocks held by dealers at the end of the year totaled 63,053 tons, compared with 70,604 tons on hand at the end of 1945 and 79,149 tons (the largest inventory on record) on May 31, 1946.

Dealers' buying prices for No. 1 copper scrap at New York averaged 10.69 cents a pound. The year opened with the price for this material at 9.12 cents, with slight advances in May, June, and July and in-

creases in November and December carrying the price to 15.75 cents at the end of the year. The average price for No. 1 composition scrap for 1946 was 10.11 cents a pound or 1.28 cents higher than the average for 1945.

Brass and copper scrap imported into and exported from the United States, 1945–46, in short tons

	1945	1946
Imports for consumption:		
Brass scrap	7,727	24,008
Scrap copper	1,348	1,030
Exports:		
Brass scrap	421	1,184
Scrap copper	133	909

SECONDARY NICKEL

The recovery of secondary nickel from nonferrous scrap in 1946 totaled 8,248 short tons, valued at $5,801,643, an increase of 27 percent over the 6,483 tons valued at $4,538,100 in 1945. The total value was calculated at 35.17 cents a pound in 1946 and 35.0 cents in 1945, the average spot-delivery price for electrolytic nickel in the 2 years. The increase in the recovery of secondary nickel was due to two factors—accelerated use of nickel-silver scrap (principally by brass mills) and a sharp increase in the quantity of metallic scrap and residues used in production of nickel chemicals.

Secondary nickel (nonferrous) recovered in the United States, 1945–46, in short tons

Secondary nickel recovered			Recoverable nickel content of scrap		
Form of recovery	1945	1946	Kind of scrap processed	1945	1946
As metal	31	299	New scrap:		
In nickel-base alloys	672	906	Nickel-base	2,203	3,190
In copper-base alloys	2,120	3,039	Copper-base	821	1,727
In aluminum-base alloys	1,364	916	Aluminum-base	1,227	666
In lead-base alloys		12			
In cast iron and steel [1]	1,702	1,225		4,251	5,583
In chemical compounds	594	1,851			
	6,483	8,248	Old scrap:		
			Nickel-base	1,449	1,911
			Copper-base	643	496
			Aluminum-base	136	250
			Lead-base	4	8
				2,232	2,665
				6,483	8,248

[1] Includes only nonferrous nickel scrap added to cast iron and steel.

Secondary nickel recovered as metal increased from 31 tons in 1945 to 299 tons in 1946, and the production of secondary monel-metal pig, shot, and castings also showed a substantial gain—from 450 tons in 1945 to 1,191 tons in 1946. Output of copper-nickel pig and shot declined from 670 tons averaging 51 percent nickel in 1945 to 350 tons, also averaging 51 percent nickel, in 1946. The year 1945 had marked

a definite change in the use of nickel-base scrap, in that a larger quantity of nickel in monel scrap than ever before was used by steel plants and foundries for alloying purposes in cast iron and steel products, and comparately insignificant tonnages of nickel-base scrap were consumed in the production of nickel as metal or in nickel-base alloys. This swing partly reversed itself in 1946, as use of nickel scrap in nickel ingot and nickel-base alloys swung back to the 1944 level; but recovery of nickel in cast iron and steel in 1946, 1,225 tons, was still considerably higher than the level of the years before 1945. Consymption of all types of nickel scrap gained over that in the previous year, the most important factors being the increased use of nickel-silver scrap in brass mills and of low-grade scrap residues by chemical plants. Stocks of nickel scrap in scrap-metal-dealers' yards declined from 2,114 tons on December 31, 1945, to 1,744 tons on December 31, 1946. However, inventories of nickel scrap at consumers' plants rose from 4,350 tons to 5,191 in the same period.

Consumption of purchased nickel scrap in the United States in 1946, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total scrap used
	New scrap	Old scrap	New scrap	Old scrap	
Pure nickel	177	43	1,209	190	1,619
Monel metal	312	2,009	1,616	290	4,227
Nickel silver	704	2,593	9,639	854	13,790
Miscellaneous nickel alloys	24	----	----	1	25
Nickel residues	997	----	1,543	991	3,531
	2,214	4,645	14,007	2,326	23,192

Although general regulation of nickel was in effect during the year under the provisions of General Preference Order M–21, which controlled the production of alloy steel and alloying materials used in steel production, this control was only nominal, and the metal was actually free of restrictions.

Dealers' buying prices for nickel scrap in New York, which were quoted at 18.50 cents a pound for nickel sheet and clips and 12.50 cents a pound for monel clips throughout 1945, remained at that level until the latter part of November 1946, when they were raised to 20.50 cents for nickel sheet and clips and 15 cents for monel clips. These increases in nickel-scrap prices followed the price increase of 3.50 cents a pound for electrolytic nickel that had been announced by the International Nickel Co. in mid-November.

No imports of nickel-bearing scrap were reported in 1945 or 1946, but exports in 1946 totaled 5,597 short tons, a substantial increase over the 2,287 short tons exported in 1945.

Consumers' stocks of purchased nonferrous nickel scrap [1] in the United States at end of year, 1945–46, gross weight in short tons

Scrap item	On hand—	
	Dec. 31, 1945	Dec. 31, 1946
Unalloyed nickel	937	225
Nonferrous nickel alloys	2,375	3,055
Nickel residues	1,038	1,911
	4,350	5,191

[1] Includes nickel-silver scrap.

SECONDARY LEAD

Operations in the secondary lead industry during 1946 reached a level second only to the record year 1941, 392,787 short tons of lead valued at $65,988,216 being recovered from scrap, compared with 363,039 tons valued at $46,468,992 recovered in 1945. Values were computed at 8.4 cents a pound in 1946 and 6.4 cents a pound in 1945, the average selling prices of all grades of primary lead exclusive of premium price payments in the 2 years. Secondary recovery thus exceeded the production of refined primary lead from domestic ores and base bullion for the second year in succession and the domestic mine production of lead for the first time, and did much to alleviate the shortage caused by low domestic production and imports of primary lead.

Secondary lead recovered in the United States, 1945–46, in short tons

Secondary lead recovered			Recoverable lead content of scrap		
Form of recovery	1945	1946	Kind of scrap processed	1945	1946
As metal:			New scrap:		
At primary plants	18,525	8,013	Lead-base	44,793	40,625
At other plants	42,598	65,691	Copper-base	[2] 8,397	7,619
	61,123	73,704		[2] 53,190	48,244
In antimonial lead [1]	194,079	193,684	Old scrap:		
In other lead alloys	77,051	94,653	Battery-lead plates	186,241	215,657
In copper-base alloys	30,346	30,101	All other lead-base	107,351	111,787
In tin-base alloys	440	645	Copper-base	[2] 16,218	17,074
			Tin-base	39	25
	301,916	319,083		[2] 309,849	344,543
	363,039	392,787		363,039	392,787

[1] Includes 42,366 tons of lead recovered in antimonial lead from secondary sources at primary plants in 1945 and 33,850 tons in 1946.
[2] Corrected figure.

Production of soft lead from scrap increased from 70,951 tons in 1945 to 76,150 tons in 1946, but the secondary lead content of antimonial lead produced showed a slight decline, from 194,079 tons in 1945 to 193,684 tons in the succeeding year. Secondary lead recovered in solder, which had declined to only 19,964 tons in 1945, increased 25 percent to 24,918 tons in 1946, whereas the secondary lead content of type metals produced showed a substantial increase for the second successive year—36,725 tons in 1946 compared with 28,525 tons in 1945 and 23,870 tons in 1944. Although total production of the secondary lead industry increased only slightly during the year, data furnished by responding companies revealed that the primary metal content of secondary lead products declined approximately 16 percent, so production from scrap increased substantially.

Shipments [1] of secondary lead, tin, and lead- and tin-alloy products in the United States in 1946, gross weight, in short tons

	Gross weight of product [2]	Secondary metal content			
		Lead	Tin	Antimony	Copper
Refined pig lead	65,932	65,932			
Remelt lead	9,470	7,458			
Lead foil	748	314			
	76,150	73,704			
Refined pig tin	2,803		2,803		
Remelt tin	241		135		
Tin foil					
	3,044		2,938		
Lead and tin alloys:					
Antimonial lead	219,626	193,684	284	12,054	
Common babbitt	41,253	28,672	1,428	2,632	36
Genuine babbitt	3,642	68	834	121	60
Other tin babbitts	1,467	577	147	90	11
Solder	67,027	24,918	4,975	340	6
Type metals	48,103	36,725	2,248	3,752	20
Miscellaneous lead-tin alloys	8,225	3,686	104	110	
	389,343	288,330	10,020	19,099	133
Composition foil	986	652	82	16	
Tin content of chemical products	404		404		

[1] Most of the figures herein represent shipments rather than production of the items involved. However, it has been necessary to record actual production figures in some instances where the information is secured from reports on that basis.

[2] Difference between gross weight of product and secondary metal content represents added primary metals or impurity content.

Of the total secondary lead recovered, 368,094 short tons were reclaimed from lead- and tin-base scrap; the remaining 24,693 tons were contained in secondary brass and bronze and reclaimed by remelting copper-base scrap. A total of 5,408 tons of lead in lead-base scrap was added to brass and bronze to bring the total recovery of secondary lead in this type of product to 30,101 tons.

Consumption of purchased lead scrap in the United States in 1946, gross weight in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total scrap used
	New scrap	Old scrap	New scrap	Old scrap	
Soft lead		43,132	68	817	44,017
Hard lead		19,855	64	1,220	21,139
Cable lead		13,995		27	14,022
Battery-lead plates		323,594		20	323,614
Mixed common babbitt		6,349	164	12,639	19,152
Solder and tinny lead		6,688	1,847	119	8,654
Type metals		18,962		142	19,104
Dross and residues	59,129		2		59,131
	59,129	432,575	2,145	14,984	508,833

The gross weight of lead-base scrap consumed during 1946 amounted to 508,833 short tons, the highest tonnage ever reported used and an increase of 8 percent over the 472,495 tons consumed in 1945. The use of battery-lead plates rose 44,143 tons, of cable-lead scrap 4,681 tons, of type-metal scrap 3,916 tons, and of mixed common-babbitt scrap 924 tons; however, consumption of drosses and residues declined 13,231 tons, of soft-lead scrap 2,541 tons, of solder and tinny-lead scrap 1,235 tons, and of hard-lead scrap 319 tons. Consumption of all lead-base scrap items showed a slow decline during the first half of the year under the influence of price restrictions in a rising market, increased substantially during July—the month in which there were no price controls because of lack of legislation—rose again slightly in October and then reached a peak for the year in December after price controls were removed.

Labor difficulties in the first 6 months of the year, both in this country and in Mexico, cut severely into the primary lead supply and threw more responsibility on secondary producers. It was apparent as early as the first quarter of 1946 that secondary smelters were meeting the emergency as best they could, for recovery from scrap in each quarter exceeded comparable figures for 1944 and 1945. However, there was a constant drain on stock piles of lead held by the Office of Metals Reserve, these inventories being reduced from about 68,000 tons on January 1 to 37,000 tons at the end of the year. A shortage of solder caused the War Assets Administration to issue instructions in September offering for sale immediately its entire stock of this alloy, to bolster the industrial supply.

Percentage metals circulated in pig form among remelters and smelters in 1946 totaled 59,541 short tons, consisting of 33,297 tons of antimonial lead, 10,563 tons of soft lead, 8,131 tons of lead babbitt, 3,672 tons of solder, 3,401 tons of type metal, 397 tons of tin babbitt, 72 tons of cable lead, 5 tons of remelt tin, and 3 tons of pewter.

Reflecting the removal of price controls late in the year, consumers' inventories of lead scrap rose from 79,974 tons on December 31, 1945, to 94,929 tons at the end of 1946. This increase was evident in all types of lead scrap—unalloyed lead scrap, lead-base alloy scrap, and drosses and residues. During the same period, stocks of secondary pig, bar, and ingot metals at these plants decreased from 28,982 short tons to 27,782 tons.

Consumers' stocks of purchased lead-base scrap in the United States at end of year, 1945–46, gross weight in short tons

Scrap item	On hand—	
	Dec. 31, 1945	Dec. 31, 1946
Unalloyed lead	3,624	4,043
Lead-base alloy	49,162	57,679
Drosses and residues	27,188	33,207
	79,974	94,929

There was considerable agitation early in the year for the OPA to readjust the price of lead above the 6.50-cent level of the war years, but it was not until June 3 that the primary lead price was raised to 8.25 cents and secondary and scrap lead adjusted accordingly. At the same time, battery-lead scrap prices were raised to reflect higher processing costs. When OPA controls were allowed to lapse on June 30, primary lead was promptly raised to 9.50 cents a pound by leading producers, causing a fluctuating market in lead scrap. When price controls were reestablished on July 26, some adjustment was expected by the industry for lead bought on the free market at a higher price, but late in August OPA made it clear that no increase in the ceiling price was contemplated and that any hoarding would call for compliance action. The lifting of price controls on November 10 brought an immediate price increase to 10.50 cents a pound, and before the end of the year lead was selling for 12.55 cents a pound, the highest price on record. With each price rise for primary metal, scrap and secondary lead were adjusted accordingly.

Dealers' buying prices for heavy-lead scrap opened the year at 5.37 cents a pound, which had been the monthly average quotation at New York since August 1942. Price changes for this type of scrap were frequent during the year, the average for December being 10.52 cents a pound and the yearly average 6.83 cents. Dealers' buying prices for battery-lead plates averaged 3.846 cents a pound for the year, being quoted at 3 cents until the first of June, 3.75 cents during June, 4.75 cents during most of July, and 4 cents from the end of July until November 12, rising to 6.25 cents at the end of the year.

General Preference Order M–38, which had controlled purchases and use of lead since 1942, was revoked December 27, 1946. However, inventories remained subject to control of the CPA under the provisions of Priority Regulation 32, consumers being allowed only a 30-day supply. Direction 5 to PR 32, which controlled dealer inventories of lead- and tin-base scrap, was continued throughout 1946. Lead was considered one of the metals in critical supply position during the year, but CPA allocated only the metal imported by the Office of Metals Reserve—the domestic market being held under surveillance, but operating without Government supervision.

Scrap-metal dealers' inventories of lead-base scrap, which were 36,734 tons on December 31, 1945, reached a peak of 41,691 tons on May 31, but declined from that point to a low mark of 29,871 tons on

December 31, 1946. Shipments of lead scrap from dealers to consumers totaled 333,190 tons during 1946, compared with 304,825 tons in the preceding year. By the end of 1946, selling of lead and tin scrap by dealers was at a peak, shipments during January 1947 reaching the highest point in the 5-year history of the dealer survey. Imports of lead scrap from other countries declined from 2,844 tons (lead content) in 1945 to 2,481 tons (lead content) in 1946.

SECONDARY TIN

Recovery of secondary tin from scrap totaled 27,671 short tons valued at $30,205,663 in 1946, a decline of 21 percent from the 35,133 tons valued at $36,538,320 in 1945. The value was computed at an average price of 54.58 cents a pound in 1946 and at 52 cents a pound in 1945.

Detinning plants produced 2,772 short tons of pig tin from old tin cans and new tin-plate clippings and 7 tons from tin-base scrap, whereas 159 tons as metal were recovered at plants of secondary smelters—recovery of unalloyed tin from scrap totaling 2,938 tons or 21 percent less than in 1945. Recovery of tin in lead-base alloys gained slightly over the 1945 figure, but recovery in solder, in tin babbitt, in chemical compounds, and in brass and bronze all declined. Shipments of secondary tin and lead-tin alloys are presented in a table in the Lead section of this chapter.

Secondary tin recovered in the United States, 1945–46, in short tons

Secondary tin recovered			Recoverable tin content of scrap		
Form of recovery	1945	1946	Kind of scrap processed	1945	1946
As metal:			New scrap:		
At detinning plants	3,527	2,779	Tin plate	2,911	2,884
At other plants	190	159	Tin-base	1,772	1,580
			Lead-base	1,360	2,280
	3,717	2,938	Copper-base	5,113	3,375
				11,156	10,119
In solder	7,740	4,975			
In tin babbitt	1,592	981			
In chemical compounds	465	404	Old scrap:		
In lead-base alloys	3,990	4,146	Tin cans	1,070	260
In brass and bronze	17,629	14,227	Tin-base	4,392	3,101
			Lead-base	5,156	4,239
	31,416	24,733	Copper-base	13,359	9,952
	35,133	27,671		23,977	17,552
				35,133	27,671

The effect of the growing scarcity of tin in the United States was reflected in the consumption of the various items of tin-base scrap. Although consumption of block-tin pipe and tin residues increased slightly, the use of tin dross, pewter scrap, and high-tin babbitt experienced substantial declines. The program of the National Lead Co. for recovering tin from excess type metal yielded 24 tons of tin in 1946 compared with 11 tons in 1945. This tin was recovered as a tin-bearing chemical residue and later reduced to pig tin at one of the detinning plants.

Consumption of purchased tin scrap in the United States in 1946, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total scrap used
	New scrap	Old scrap	New scrap	Old scrap	
Block-tin pipe, scrap, and foil		761	1	84	846
Tin scruff and dross	2,519				2,519
No. 1 pewter		64			64
High-tin babbitt		2,615		27	2,642
Residues	151				151
	2,670	3,440	1	111	6,222

Use and quota controls on tin, as administered under General Preference Order M–43, were continued throughout the year and into 1947. Import purchase of tin by the Government exclusively was also continued. As the decline in receipts of tin-base scrap at secondary smelters' plants revealed a progressive scarcity of this metal, Order M–43 was again amended on July 5, placing secondary tin under allocation for the first time—secondary tin being defined as any tin-bearing scrap or residue containing less than 95 but more than 1.50 percent of tin. On October 25, another amendment to Order M–43 permitted an increase in the quantity of tin used in the production of babbitt and bearings. This action was taken, not because of any increase in the supply of tin but because the bearing industry itself was threatened.

Consumers' stocks of purchased tin-base scrap in the United States at end of year, 1945–46, gross weight in short tons

Scrap item	On hand–	
	Dec. 31, 1945	Dec. 31, 1946
Unalloyed tin	69	86
Tin-base alloys	191	299
Drosses and residues	762	1,414
	1,022	1,799

Dealers' buying prices on block-tin-pipe scrap at New York remained at the 1945 level of 45.50 cents a pound until July 18, when the price increased to 48.50 cents and remained at that figure until price control was lifted on November 10, after which it advanced to 61 cents. Scrap-metal dealers reported shipments of tin babbitt and pewter totaling 791 tons to consumers during the year, and shipments of block-tin pipe amounted to 155 tons. These figures indicate that most shipments of tin scrap went directly to consumers from industrial sources instead of passing through dealer channels. No imports of tin dross were reported during 1946, and imports in 1945 totaled only 57 long tons. However, exports of tin scrap and waste totaled 6,684 long tons in 1946, compared with 3,453 tons in 1945.

Detinning Plants—Eight detinning plants reported operations in 1945: Johnston & Jennings Co., Metal & Thermit Corp. (three plants),

Standard Metal Refining Co., Vulcan Detinning Co. (two plants) and the Southern Detinning Co. The last-named plant, at Birmingham, Ala., was a Government-owned plant which closed May 10, 1946. There was an insufficient tonnage of tin-plate clippings and old cans during 1946 to keep these plants operating at capacity because of a precipitate decline in the quantity of old tin cans made available for treatment.

Secondary tin recovered at detinning plants in the United States, 1945–46

	1945	1946
Scrap treated:		
Clean tin plate, long tons	257,545	249,813
Old tin-coated containers, do	114,311	28,434
	371,856	278,247
Tin recovered from new tin-plate clippings, short tons	2,911	2,884
Tin recovered from old tin-coated containers, do	1,070	260
	3,981	3,144
Tin recovered as metal, short tons	[1] 3,527	[1] 2,772
Tin recovered in compounds, do	454	372
	[2] 3,981	[2] 3,144
Weight of tin compounds produced, short tons	933	757
Average quantity of tin recovered per long ton of clean tinplate scrap used, pounds	22.61	23.0
Average quantity of tin recovered per long ton of old tin-coated containers used, pounds	18.73	18.33
Average delivered cost of clean tin-plate scrap, per long ton	$14.18	$14.37
Average delivered cost of old tin-coated containers, do	$14.09	$13.98

[1] Includes a small tonnage of pig tin of less than standard purity and, consequently, subject to further refining or alloying.

[2] Recovery from tin-plate clippings and old containers only. In addition, detinners recovered 11 tons of tin as metal from tin-bearing chemical residues in 1945 and 30 tons of tin as metal and 8 tons of tin in compounds from tin-base scrap and residues in 1946.

After the end of the war, tin-can collection systems in the larger cities were discarded because the cans were no longer prepared for collection by housewives. Conservation Order M–325, which directed the delivery of tin-plate scrap and old tin cans to detinning plants, continued in effect until November 26, 1946. The CPA revoked the order on that date, explaining its action with the statement that the quantity of such scrap had been negligible during recent months. The plant at Birmingham, which was designed to treat unprepared tin cans and should have been assured of a raw material supply, was closed, not for this reason but because of high operating costs.

Almost all of the loss in tin recovered was from old cans, as that reclaimed from new tin-plate clippings declined only 1 percent—from 2,911 short tons in 1945 to 2,884 tons in 1946. Tin recovered from old tin-coated containers fell 76 percent—from 1,070 tons in 1945 to only 260 tons in 1946. A total of 249,813 long tons of clean tin-plate clippings was made available to detinners for treatment in 1946, compared to 257,545 tons in the preceding year, but the quantity of old tin cans treated was only 28,434 tons in 1946 compared with 114,311 tons in the preceding year.

The average quantity of tin recovered per long ton of clean tin-plate scrap used increased from 22.61 pounds in 1945 to 23.09 pounds in 1946, indicating a slightly heavier average coating of tin on new clippings during the year. However, the average quantity of tin recov-

ered per long ton of old tin-coated containers used continued a steady decline, dropping to 18.33 pounds in 1946 compared with 18.73 pounds in 1945. Of the 3,144 short tons of tin recovered, 2,772 tons were reclaimed as metal in the form of pigs and anodes and 372 tons in the form of tin compounds. These figures are comparable to the 1945 recovery of 3,527 tons as metal and 454 tons in compounds. In addition, detinners treated tin-bearing chemical residues and tin-base scrap to recover 30 tons of tin as metal and 8 tons of tin in compounds in 1946.

Imports of tin-plate scrap increased from 18,072 long tons in 1945 to 24,530 tons in 1946. Exports of tin-plate scrap, circles, waste-waste, and clippings declined from 14,710 long tons in 1945 to 11,451 tons in 1946.

SECONDARY ANTIMONY

Secondary antimony recovered from lead- and tin-base scrap totaled 19,115 short tons valued at $6,617,613 in 1946, a gain of more than 11 percent over the 17,148 tons valued at $5,432,487 recovered in 1945. The value was computed at 17.31 cents a pound in 1946 and 15.84 cents a pound in 1945—the average selling price for ordinary American-brand antimony in the 2 years at New York.

Secondary antimony recovered in the United States, 1945–46, in short tons

Secondary antimony recovered			Recoverable antimony content of scrap		
Form of recovery	1945	1946	Kind of scrap processed	1945	1946
In antimonial lead	11,223	12,054	New scrap:		
In other lead alloys	5,712	6,850	Lead-base	2,097	3,010
In tin-base alloys	213	211	Tin-base		
	17,148	19,115		2,097	3,010
			Old scrap:		
			Lead-base	14,766	15,925
			Tin-base	285	180
				15,051	16,105
				17,148	19,115

Old battery plates were the principal source of antimony recovered from scrap in 1946, as in the past. Even without the removal of price controls during the year, treatment of battery plates would have been more extensive than in 1945, but unloading of this scrap item by non-ferrous scrap dealers during the price "holiday" in July, and after the removal of price controls November 10, resulted in consumption of an unprecedented quantity by smelters and refiners. The tonnage of battery plates consumed increased from 279,471 tons in 1945 to 323,614 tons in 1946. This resulted in the recovery of 10,193 tons of antimony from this source during the year, an increase of 16 percent over the 8,804 tons reclaimed in 1945. Although the quantity of antimony recovered in antimonial lead and in other lead-base alloys was greater than in 1945, recovery of antimony in tin-base alloys declined. Remelters, smelters, and refiners recovered 94 percent of the antimony

reclaimed in 1946, the other 6 percent being recovered by bearing manufacturers and other foundries. Data on consumption of purchased scrap from which antimony was recovered may be found in the tables on the consumption of lead-base and tin-base scrap in the sections of this chapter devoted to those metals. Products in which antimony was recovered are included in the lead- and tin-products table.

During 1946 a larger quantity of antimonial-lead scrap than usual was "softened" to produce soft lead, and the resulting high-antimony drosses were consumed in other products. As a result of this operation, a study of reports made to the Bureau of Mines and to CPA was conducted to establish the fact that all antimony recovered from scrap remained in the alloyed state, none being regained as unalloyed metal or in chemical compounds. With the supply situation in primary antimony acute, the high-antimony lead drosses produced in the softening operations found a ready sale for their antimony content. Most of this work was carried out at secondary lead smelters, however, since the quantity of soft lead recovered at primary plants during the year was considerably below that in 1945.

Because of the continuing shortage of antimony, the CPA retained all restrictions on uses and inventories of the metal and continued allocating it under the provisions of General Preference Order M–112 throughout the year. Antimony ore and metal, which had been removed from import control in November 1944, were again placed under control in October 1946. The purpose of this action was to stop importation of ore concentrates for reexport of metal, a practice that would seriously interfere with the Government purchase program. However, on November 30 all restrictions on the importation of antimony were removed.

Antimony in all forms remained under price control until November 10, 1946—the effective date of OPA Supplementary Order 193 (announced November 12) which ended control of prices on all metals and minerals as well as hundreds of other items. On November 12, immediately after the order became effective, the wartime antimony price of 14.50 cents a pound at Laredo, Tex., was advanced to 23.50 cents and in December rose to 28.25 cents. The record high for antimony of 45 cents a pound occurred in 1916, when there were enormous demands for the metal for use in shrapnel, but the top price in peacetime had been 25 cents in 1926.[4]

SECONDARY ZINC

Secondary zinc recovered in 1946 from purchased scrap and residues totaled 300,682 short tons, with a value of $53,521,396, calculated at 8.9 cents a pound, the average selling price for the year of all grades of refined zinc, not including bonuses paid by the Office of Metals Reserve under the Premium Price Plan. This total was 17 percent lower than in 1945, when 360,444 tons, with a value of $61,996,368 at 8.6 cents a pound, were recovered.

[4] American Metal Market, vol. 53, No 242, Dec. 18 ,1946, pp. 1, 5

Secondary zinc [1] recovered in the United States, 1945–46, in short tons

Secondary zinc recovered			Recoverable zinc content of scrap		
Form of recovery	1945	1946	Kind of scrap processed	1945	1946
As metal:			New scrap:		
By distillation:			Zinc-base	[2] 114,308	115,245
Slab zinc	48,816	44,139	Copper-base	[2] 153,643	107,548
Zinc dust	23,416	25,638	Aluminum-base	1,227	666
By remelting	11,704	11,659		[2] 269,178	223,459
	83,936	81,436	Old scrap:		
In zinc-base alloys	6,531	9,953	Zinc-base	[2] 25,127	27,690
In brass and bronze	226,756	163,374	Copper-base	[2] 66,038	49,336
In aluminum-base alloys	1,355	890	Aluminum-base	101	197
In chemical products:				[2] 91,266	77,223
Zinc oxide (lead free)	9,130	11,084			
Zinc sulfate	3,216	3,573		360,444	300,682
Zinc chloride	[2] 11,873	12,267			
Lithopone	15,647	17,017			
Miscellaneous	[2] 2,000	1,088			
	276,508	219,246			
	360,444	300,682			

[1] Zinc content.
[2] Revised figure.

This decrease in recovery of zinc from scrap can be ascribed to decreased activity of brass mills, brass foundries, and fabricators due to unsettled conditions—the aftermath of war. Secondary zinc recovered in brass and bronze was 28 percent less than in 1945, but the total zinc recovered from scrap in products other than brass and bronze was 137,308 tons in 1946 compared with 133,688 tons in 1945. In that year, 61 percent of all secondary zinc recovered came from brass and bronze scrap, but in 1946 the percentage fell to 52. The secondary zinc plants were less affected by the conversion period than were generators or consumers of copper-base scrap, and in the final quarter of 1946 a number of records for monthly output of secondary zinc products and consumption of zinc scrap were broken. The 1946 decrease in zinc recovered from copper-base scrap was due to unusual conditions; but if history repeats itself, the recovery of zinc from brass scrap in peacetime will be less than during the war years. In wartime, military demands cause the brass and bronze industries to be the largest consumers of zinc; but normally, galvanizing occupies first place. Increased galvanizing activity means increased generation of zinc residues, such as galvanizers' dross, skimmings, and sal skimmings; in general, increased generation of such plant scrap means increased consumption of scrap and increased secondary recovery of zinc as metal and in chemicals.

Total production of secondary zinc products increased from 133,853 tons in 1945 to 138,195 tons in 1946; and only two items, redistilled slab and rolled zinc, registered decreases. The output of lithopone and lead-free zinc oxide, although greater than in 1945, failed to meet the demand for their use in paints and pigments. The increase in zinc dust can be attributed to its increased use in the manufacture of sodium hydrosulfite, which is employed in making paper. Although zinc dust enters into the chemical processes incidental to the making of sodium hydrosulfite, zinc is not an element of the

product but can be recovered from the residues of the process as a byproduct, in the form of lead-free zinc oxide or carbonate.

Production of secondary zinc and zinc-alloy products in the United States, 1945–46, gross weight in short tons

Products	1945	1946
Redistilled slab zinc	49,242	44,516
Zinc dust	23,892	26,002
Remelt spelter [1]	8,090	8,212
Remelt die-cast slab	4,727	7,829
Zinc-die and die-casting alloys	2,281	3,002
Galvanizing stock	701	876
Rolled zinc	3,054	2,729
Secondary zinc in chemical products	41,866	45,029

[1] Contains small tonnages of zinc anodes.

Zinc scrap was used by 24 distillers in 1946. Of these, 13 made only redistilled slab, 6 made only dust, and the other 5 made both slab and dust. The 22 who distilled scrap in 1945 carried on the same kind of operations in 1946. One plant distilled zinc scrap for the first time in 1946, and 1 distiller who had not used scrap in 1945 did use it in 1946. Only 3 of these distillers could be described as primary plants using horizontal retorts only; 2 had equipment for both primary and secondary smelting, and the other 19 were secondary plants. All zinc dust is made in secondary plants using vertical retorts. The horizontal retorts used in primary plants are too small and too closely spaced to be conveniently used with the steel boxes employed for condensing zinc dust; but some primary plants distill solid scrap, or flue dust mixed with ore, in horizontal retorts to make slab zinc.

Production of heavy zinc chemicals was carried on in 39 plants. In addition to the distillers and chemical plants, 84 secondary smelters, die-casters, galvanizers, and miscellaneous remelters were covered by the monthly zinc-scrap survey, and these 147 plants accounted for 95 percent of the total recovery of secondary zinc from zinc-base scrap by all plants, including those reporting only on an annual basis.

Consumption of purchased zinc scrap in the United States in 1946, gross weight, in short tons

Scrap item	Remelters, smelters, and refiners		Manufacturers and foundries		Total scrap used
	New scrap	Old scrap	New scrap	Old scrap	
Clippings	4,534		4,771		9,305
Sheet and strip		4,484		234	4,718
Engraver's plates		1,760		127	1,887
Skimmings and ashes	44,176		31,798		75,974
Dross	49,879		668		50,547
Die castings		19,024	217	185	19,426
Rod and die scrap		7,441			7,441
Flue dust and residues	14,338		23,240		37,578
	112,927	32,709	60,694	546	206,876

Zinc-base-scrap consumption totaled 206,876 tons in 1946, 2 percent more than in 1945. Monthly consumption was greatest in the latter

part of the year, exceeding 19,000 tons in each of the last 3 months. The most notable increase in consumption for the year was the 72 percent rise in the treatment of die-cast scrap, paralleling the increased manufacture and use of zinc die castings.

Consumers' stocks of purchased zinc-base scrap in the United States at end of year, 1945–46, gross weight in short tons

Scrap item	On hand—	
	Dec. 31, 1945	Dec. 31, 1946
Metallic zinc scrap	10,903	9,740
Dross	6,605	6,138
Skimmings and residues	21,670	18,723
	39,178	34,601

The supply of zinc scrap was plentiful in 1946 compared to that of most other metals. This is usually true because most of the zinc scrap treated consists of byproduct residues such as skimmings, dross, and flue dust. Some of these are low-grade and in slack times accumulate because they are unmarketable, but when scrap is scarce they are more easily disposed of and take the place, to some extent, of the higher-grade items.

Scrap-metal dealers shipped 66,814 tons of zinc scrap to consumers in 1946 compared with 56,491 tons in 1945 and 42,771 tons in 1944. Dealers' stocks of zinc scrap at the end of the year amounted to 13,547 tons, or 3,817 tons more than at the end of 1945, although total stocks of nonferrous scrap declined from 174,677 tons on December 31, 1945, to 161,467 tons on December 31, 1946.

Zinc was not under allocation in 1946, and there were no restrictions on the use of zinc or zinc scrap; but ceiling prices were in effect all year, except between June 30 and July 26, when Maximum Price Regulation 3 was not in effect, and after November 10, the date on which President Truman ended price control. On March 16, the OPA issued an amendment to MPR 3 establishing a maximum price of 9.25 cents per pound for high-grade secondary slab zinc. No ceiling price for that grade had been provided when ceilings were originally established, because at that time no high-grade secondary zinc was being produced. Ceiling prices for other grades of secondary slab zinc remained the same as in 1945 (except during July) until October 14, when OPA raised maximum prices of primary and secondary slab zinc 1 cent a pound. Prices of all grades of scrap zinc were raised three-quarters of a cent a pound, and prices of zinc chemicals were raised according to their zinc content. With removal of price controls on November 10, the price of Prime Western slab zinc at St. Louis rose quickly to 10.50 cents a pound and remained there for the rest of the year.

Dealers' buying prices for new zinc clippings averaged 6.03 cents a pound in 1946, compared with a monthly average of 5.83 cents in 1945 and 5.81 cents in 1944. The average monthly price for old zinc scrap was 4.70 cents a pound. For most of 1944 and all of 1945, it had remained at 4.37 cents. Higher prices during the parts of the

year when prices were not limited accounts for the increase in the 1946 average price for both types of scrap.

Imports of old zinc scrap into the United States totaled 1,286 tons in 1946 compared with 3,008 tons (revised figure) in 1945. Imported drosses and residues totaled 2,851 tons in 1946, a decrease of 1,472 tons from the 4,323 tons received from abroad in 1945. Large quantities of fume from a primary smelter in Canada were imported by one company for the manufacture of zinc sulfate and lithopone; the zinc reclaimed from this material was not counted as secondary metal but as recovered from material other than scrap.

Slate

By ROBERT W. METCALF AND M. G. DOWNEY

GENERAL SUMMARY

PARALLELING the high level of private residential construction and a record private nonresidential building program, sales of slate in 1946 totaled 759,770 short tons valued at $8,844,106, 4 percent higher (in quantity) than the former peak of 727,700 tons in 1924. Compared with 1945, total sales in 1946 increased 38 percent in quantity and 56 percent in value. Slate sold as dimension stone was 38 percent greater in quantity and 73 percent higher in value in 1946 than in 1945.

Sales of roofing slate, the highest since 1942, increased 45 percent in quantity and more than doubled in value compared with 1945,

Salient statistics of the slate industry in the United States, 1945–46

	1945			1946				
	Quantity		Value	Quantity		Value	Percent of change in—	
	Unit of measurement	Approximate equivalent short tons		Unit of measurement	Approximate equivalent short tons		Quantity (unit as reported)	Value
Domestic production (sales by producers):								
Roofing slate	*Squares* 101,300	38,240	$976,122	*Squares* 146,790	56,240	$1,982,928	+45	+103
Mill stock:								
Electrical slate	*Sq. ft.* 363,210	3,100	283,650	*Sq. ft.* 389,210	2,760	366,039	+7	+29
Structural and sanitary slate	314,200	2,480	135,671	448,520	3,530	222,675	+43	+64
Grave vaults and covers	314,710	2,850	88,146	145,910	1,330	58,671	−54	−33
Blackboards and bulletin boards	649,510	1,650	170,392	808,710	2,090	240,520	+25	+41
Billiard-table tops	158,580	1,160	56,453	292,740	2,180	135,217	+85	+140
School slates	[1] 307,570	280	8,033	[1] 286,730	260	9,462	−7	+18
Total mill stock	2,107,780	11,520	742,345	2,371,820	12,150	1,032,584	+13	+39
Flagstones, etc.[2]	2,995,670	19,900	253,273	4,322,220	27,860	403,990	+44	+60
Total slate as dimension stone		69,660	1,971,740		96,250	3,419,502	+38	+73
Granules and flour		482,230	3,687,173		663,520	5,424,604	+38	+47
Grand total domestic production		551,890	5,658,913		759,770	8,844,106	+38	+56

[1] Square feet approximate. Number of pieces: 1945, 353,400; 1946, 535,950.
[2] Includes slate used for walkways, stepping stones, and miscellaneous uses.

achieving a rapid recovery from the low point of 1944. The average value per square in 1946 was $13.51, or 40 percent higher than that reported in 1945 ($9.64). In Pennsylvania, roofing-slate sales jumped 49 percent in quantity and 99 percent in value. Total sales in Vermont and Maine in 1946 were 25 percent higher in quantity and 104 percent higher in value than those reported for New York, Vermont, and Maine in 1945. Sales in the Buckingham district, Virginia, also registered a large increase in the number of squares sold and a much greater gain in value of sales.

The stepped-up construction activity, particularly in nonresidential building, was reflected directly in the enhanced demand for slate sold as mill stock. Total sales of the products included in this classification increased 13 percent in quantity and 39 percent in value. Blackboards, structural and sanitary slate, and billiard-table tops showed very large gains in 1946, particularly billiard-table tops. Sales of electrical slate were 7 percent higher than in 1945. On the other hand, sales of grave vaults and covers declined more than 50 percent, and school slates decreased slightly. Sales of flagstones, stepping stones, and similar products rose to a new high of 4,322,220 square feet valued at $403,990, surpassing 1941's previous record in quantity by 44 percent and 1945's former record value by 60 percent.

Slate granules are used in making roofing materials that compete in the roofing-slate market, but most of the slate employed in the manufacture of granules and flour is unsuited for other slate products. Sales of granules and flour in 1946 were the highest on record. Figures for sales of granules of all kinds, including slate, are given in the chapter on Stone in this volume.

The preceding table presents the principal statistical data for the slate industry in 1945 and 1946.

SALES

Dimension Slate.—The term "dimension slate" is applied to blocks or slabs of specified sizes and shapes. It includes all slate products except granules and flour. The following table indicates sales of dimension slate for the latest 5-year period.

As roofing slate is used chiefly in residential building, a comparison of roofing-slate sales with the number of new dwelling units serves to highlight a rather interesting trend. (See fig. 1.) From 1929 through 1938 slate sales compared favorably with the normally expected requirements of the small building programs in those years, but since 1938 they have fallen far below the normal demands of new dwelling units erected. This situation probably was due to the preponderance of low-priced and temporary housing, for which slate is not a suitable material.

Mill-stock slate is used most extensively in nonresidential building, and sales have followed rather closely the trend of new nonresidential construction since 1925. The relationships are shown in figure 1.

Figure 2 presents graphically a statistical history of slate over a 32-year period, by uses. The chart illustrates the decline of activity in the slate industry, brought about by both wars and depressions.

Figure 3 presents the history of slate production by uses on a quantity basis. Note that "granules and flour"—large-tonnage products

with relatively low unit value—assume greater prominence in this chart than in figure 2.

Dimension slate sold by producers in the United States, 1942–46

Year	Roofing			Mill stock		Other [1]		Total	
	Squares	Approximate equivalent short tons	Value	Approximate short tons	Value	Approximate short tons	Value	Approximate short tons	Value
1942	192,070	71,400	$1,704,053	18,720	$1,112,426	16,910	$139,328	107,030	$2,955,807
1943	96,220	35,370	841,750	15,950	938,368	21,990	166,231	73,310	1,946,349
1944	89,090	32,750	802,179	12,440	715,689	15,760	203,090	60,950	1,720,958
1945	101,300	38,240	976,122	11,520	742,345	19,900	253,273	69,660	1,971,740
1946	146,790	56,240	1,982,928	12,150	1,032,584	27,860	403,990	96,250	3,419,502

[1] Includes flagstones, walkways, stepping stones, and miscellaneous slate.

Granules and Flour.—Sales of granules, which are used chiefly in surfacing prepared roofing, were 37 percent higher in quantity and 47 percent higher in value in 1946 than in 1945. Slate flour, largely a byproduct of granule manufacture, is used as a filler in road-asphalt surface mixtures, paints, roofing mastic, linoleum, and other products. Sales of this material increased slightly more than did those of granules. Stimulated by the increased tempo of building construction in 1946, sales of granules and flour combined established a new record. Granules were produced in Vermont, Pennsylvania, New York, Georgia, and Maryland, with smaller quantities from Virginia, Arkansas, and California. Sales of granules and flour for the latest 5-year period are indicated in an accompanying table.

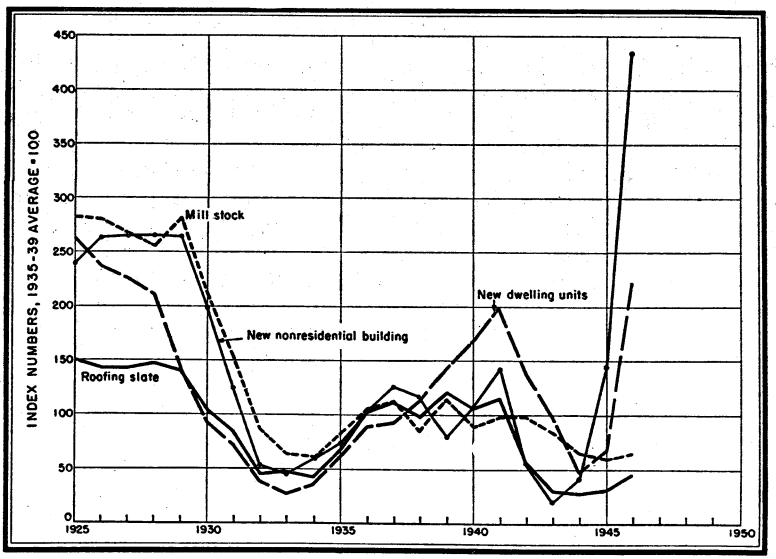

FIGURE 1.—Sales of roofing slate and mill stock compared with the number of new dwelling units and value of new nonresidential building, 1925–46. Data on new nonresidential building from U. S. Department of Commerce (joint estimates of U. S. Department of Commerce and U. S. Department of Labor, beginning 1944), and on new dwelling units from U. S. Department of Labor.

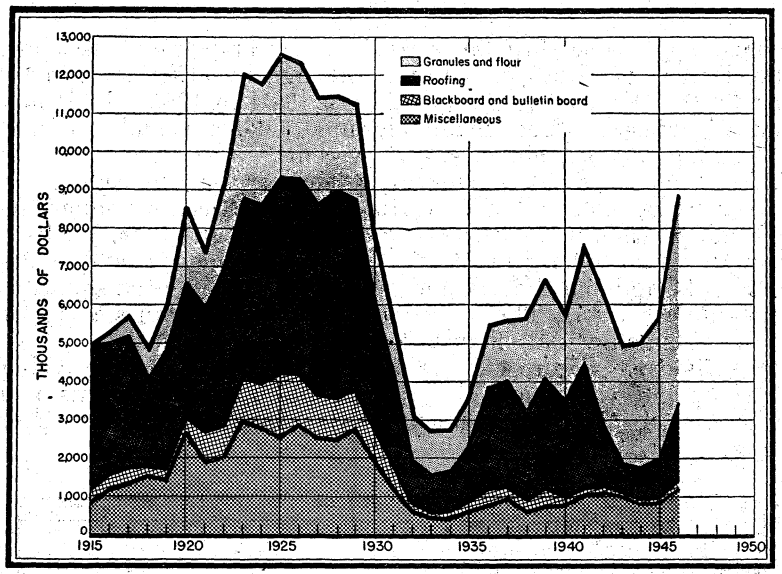

FIGURE 2.—Value of slate sold in the United States, 1915–46, by uses.

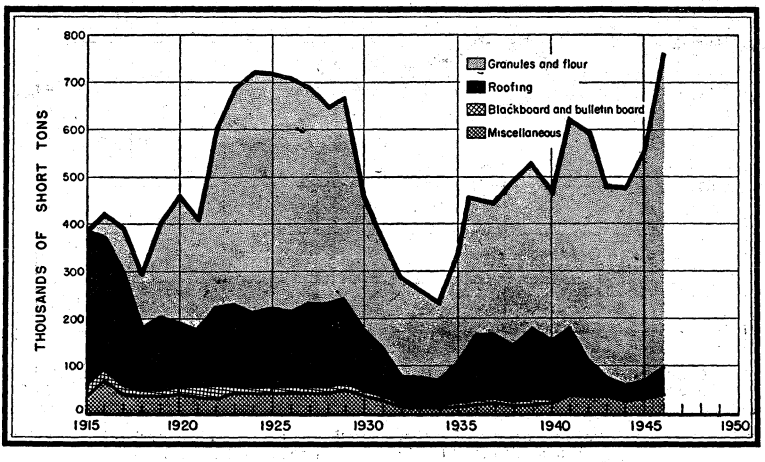

FIGURE 3.—Quantity of slate sold in the United States, 1915–46, by uses.

Crushed slate (granules and flour) sold by producers in the United States, 1942–46

Year	Granules		Flour		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1942	356, 510	$2, 955, 562	127, 230	$448, 854	483, 740	$3, 404, 416
1943	292, 330	2, 547, 399	103, 220	376, 489	395, 550	2, 923, 888
1944	309, 170	2, 861, 014	107, 720	422, 223	416, 890	3, 283, 237
1945	374, 800	3, 299, 593	107, 430	387, 580	482, 230	3, 687, 173
1946	513, 780	4, 851, 314	149, 740	573, 290	663, 520	5, 424, 604

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PRICES

The average value of roofing slate, f. o. b. quarry or mill, as reported to the Bureau of Mines, was 40 percent higher in 1946 than in 1945, rising to $13.51 a square compared with $9.64 in 1945. In Pennsylvania it increased 33 percent, in Virginia 61 percent, and in the New York-Vermont and Maine areas 63 percent.

After remaining at 35 cents a square foot for the 4 preceding years, the average value of mill stock in 1946 rose to 44 cents a square foot. The average value of electrical slate increased 16 cents, vaults and covers 12 cents, billiard-table tops 10 cents, structural and sanitary slate 7 cents, and blackboards and bulletin boards 4 cents a square foot compared with 1945. The average sales value of granules a short ton rose 64 cents and of slate flour 22 cents.

Price History.—Figure 4 shows the trend of annual average value of slate compared with wholesale prices of all building materials over a 32-year period. During recent years they have been in remarkably close accord.

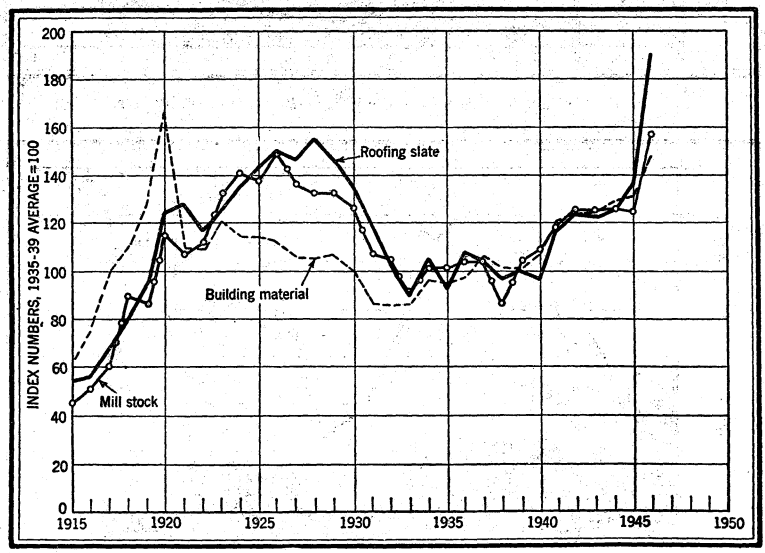

FIGURE 4.—Average value of slate compared with wholesale prices of building materials in general, 1915–46. Wholesale prices from U. S. Department of Labor.

REVIEW BY STATES AND DISTRICTS

The increased demand and market for slate has resulted in the reopening of a number of quarries closed during the war period as well as in new operations in several of the slate-producing districts. Three new producers of roofing and flagging were reported in Pennsylvania (the Lehigh area) and six new firms in New York, all of them producing flagging in Washington County. Another new firm reported output of roofing and flagging in Vermont. The accompanying table gives sales of slate in 1946, by States and uses.

Slate sold by producers in the United States in 1946, by States and uses

State	Operators	Roofing		Mill stock		Other uses (value) [1]	Total value
		Squares (100 square feet)	Value	Square feet	Value		
Arkansas	1					(2)	(2)
California	1					(2)	(2)
Georgia	1					(2)	(2)
Maryland	1					(2)	(2)
New York	13					$1,160,404	$1,160,404
Pennsylvania [3]	20	113,490	$1,401,427	2,010,650	$662,045	1,134,273	3,197,745
Vermont and Maine	19	20,010	348,161	361,170	370,539	2,171,093	2,889,793
Virginia	5	13,290	233,340			(2)	(2)
Undistributed						1,362,824	1,596,164
Total: 1946	61	146,790	1,982,928	2,371,820	1,032,584	5,828,594	8,844,106
1945	46	101,300	976,122	2,107,780	742,345	3,940,446	5,658,913

[1] Flagging and similar products, granules, and flour.
[2] Included under "Undistributed."
[3] For details of production in Pennsylvania, see following table.

Maine.—The principal product of the quarries near Monson is electrical slate. Minor quantities of roofing slate and vaults and covers were also produced in 1946. As in 1944 and 1945, only one company was active.

New York-Vermont.—In order that the output of an individual firm may not be revealed, Maine has been included with Vermont in the accompanying table. The total value of slate products sold in 1946 in Vermont and Maine was 51 percent greater than in 1945, although the figures are not quite comparable because roofing-slate production in New York is included with that of Vermont and Maine in 1945, and no output of this item from that State was reported in 1946. Roofing-slate production in Vermont showed large gains in 1946, and sales of the colored slates of this region may be expected to increase substantially when the proportion of moderate-to high-priced residential units rises. Production in New York, which consisted chiefly of granules and flour, was considerably higher in 1946 than in 1945.

An outstanding development in the New York-Vermont slate-producing area was the reported purchase by the Idea Development Corp., Buffalo, N. Y., of 18 quarries from the H. G. Williams Slate Co., in order to obtain material for the manufacture of slate brick and tile. The brick, which are to be used in building fronts, will be sawed from solid slate, and the tile will be manufactured from the varicolored quarry waste abundantly available in the district. Roofing and mill stock also will be produced. In addition to the New York and Vermont slate quarries acquired, the new owners also purchased two marble quarries and another slate quarry in Georgia, according to the trade press.[1]

Peach Bottom District.—In 1946 the slate quarries in the area near Cardiff, Md., and Delta, Pa., produced only granules, although high-quality roofing is a potential product.

Lehigh District.—The quarries of Lehigh and Northampton Counties, Pa., furnish all types of slate products and comprise the

[1] Pit and Quarry, vol. 39, No. 7, January 1947, p. 87.

most productive slate area in the United States. As separate figures may not be shown for York County, which includes part of the Peach Bottom district, it is included with Northampton County in the accompanying table giving detailed figures for Pennsylvania.

The total value of all slate products sold in the Lehigh district in 1946 increased 66 percent compared with 1945. Sales of roofing slate were 49 percent higher in quantity and nearly double in value. The total value of all mill products sold rose 43 percent compared with 1945. Sales of all products except vaults and covers and school slates showed very large increases. The percentage gains in 1946 over 1945 were as follows: Electrical slate, 32 percent in quantity and 31 percent in value; structural and sanitary, 39 percent in quantity and 56 percent in value; blackboards and bulletin boards, 25 percent in quantity and 41 percent in value; and billiard-table tops, 90 percent in quantity and 152 percent in value. Sales of school slates, however, declined 7 percent in quantity, although the sales realization increased 18 percent, and sales of grave vaults and covers dropped 54 percent in quantity and 33 percent in value. The value of miscellaneous products (granules and flour, flagstones, etc.) increased 49 percent. Most of the slate in this area is a blue-black "soft-vein," well adapted for structural products as well as for roofing. Detailed figures for production in Pennsylvania are given in the accompanying table.

Slate sold by producers in Pennsylvania in 1946, by counties and uses

County	Operators	Roofing slate		Mill stock					
				Electrical		Structural and sanitary		Vaults and covers	
		Squares (100 square feet)	Value	Square feet	Value	Square feet	Value	Square feet	Value
Lehigh	5	10,120	$82,086	36,960	$15,536	2,620	$1,624	(1)	(1)
Northampton and York [2]	15	103,370	1,319,341	32,060	11,935	413,750	195,433	142,670	$56,819
Total: 1946	20	113,490	1,401,427	69,020	27,471	416,370	197,057	142,670	56,819
1945	17	75,970	704,061	52,240	21,050	298,790	126,173	308,100	84,958

County	Mill stock—Continued						Other uses (value)	Total value
	Blackboards and bulletin boards		Billiard-table tops		School slates			
	Square feet	Value	Square feet	Value	Square feet	Value		
Lehigh	94,550	$23,110			286,730	$9,462	$112	$131,930
Northampton and York [2]	714,160	217,410	287,150	$130,716			1,134,161	3,065,815
Total: 1946	808,710	240,520	287,150	130,716	286,730	9,462	1,134,273	3,197,745
1945	649,470	170,359	151,360	51,859	307,570	8,033	763,248	1,929,741

[1] Small amount of slate for grave vaults and covers produced in Lehigh County included under Northampton and York Counties.
[2] York County produced granules and flour only.

Virginia.—The principal product of the Buckingham County quarries is roofing slate. The high quality of Virginia slate, which is dark gray or slightly greenish with a lustrous surface, has been main-

tained through many years of satisfactory service. The output in 1946 increased 43 percent in quantity and 130 percent in value compared with 1945. Substantial amounts of granules also are produced in Virginia; because of the small number of operators, however, sales may not be shown.

Other Districts.—Slate products, principally granules and flour, were produced in Montgomery County, Ark., near Glenwood; near Placerville, El Dorado County, Calif.; and in Bartow County, Ga., near Fair Mount.

FOREIGN TRADE [2]

Imports.—The value of slate imported for consumption has been very small during recent years, amounting to only $616 in 1946, nil in 1945 and 1943, $51 in 1944, $177 in 1942, and $1,648 in 1941.

Exports.—The following table gives the value of exports of slate products for the latest 5-year period as reported to the Bureau of Mines by shippers. In 1946 the total value of exports as shown rose 23 percent over 1945 to $508,462.

Slate exported from the United States, 1942–46, by uses [1]

Use	1942	1943	1944	1945	1946
Roofing	(2)	(2)	$5,398	$3,465	$7,103
School slates [3]	$26,481	$18,939	24,008	4,751	21,701
Electrical	6,163	3,461	3,782	2,490	5,117
Blackboards	6,112	5,861	14,674	20,211	40,294
Billiard tables	54,669	87,834	75,797	161,439	47,605
Structural [4]	(2)	(2)	180,697	2,316	386,642
Slate granules and flour	(2)	(2)		219,933	
Undistributed	146,794	150,346			
	240,219	266,441	304,356	414,605	508,462

[1] Figures collected by the Bureau of Mines from shippers of products named.
[2] Included under "Undistributed."
[3] Includes slate used for pencils and educational toys.
[4] Includes slate for floors and walkways.

WORLD REVIEW

The American consulate general, Halifax, Nova Scotia, reports that the Acadia Slate Co., with an authorized capital of $300,000, has been organized to quarry a promising deposit near New Minas, Nova Scotia, and to manufacture slate shingles. The deposit is located near tidewater, and the operators expect to ship their products by water to Great Britain and New England points as well as to serve the eastern Canadian market.

The preparation and the desirable qualities of roofing slate in Great Britain were discussed by Robin.[3] Underground mining for slate in the Angers Basin, in eastern France, and manufacturing processes used in dressing and finishing slate in that country were described in detail.[4] The principal product is roofing slate, although a wide variety of other slate products is marketed, chiefly in France and England.

[2] Figures on imports and exports (unless otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.
[3] Robin, P., Slate: Ann. Inst. Tech. vol. 5, 1940, pp. 27-34. Chimie et industrie, vol. 47, 1942, p. 62; Chem. Abs., vol. 40, No. 21, Nov. 10, 1946, p. 6780.
[4] Gradel, S., French Slate Industry: Compressed Air Mag., vol. 51, No. 9, September 1946, pp. 237-243.

Stone

By G. W. JOSEPHSON AND NAN C. JENSEN

	PAGE
General summary	1102
Dimension stone	1105
Salient statistics	1105
Building stone	1107
Granite	1107
Basalt and related rocks (trap rock)	1109
Marble	1110
Limestone	1111
Sandstone	1113
Miscellaneous stone	1115
Trends in use of dimension stone	1115
Technologic developments	1117
Crushed and broken stone	1117
Salient statistics	1118
Crushed and broken stone—Con.	
Commercial and noncommercial operations	1119
Granules	1120
Size of plants	1121
Methods of transportation	1121
Granite	1122
Basalt and related rocks (trap rock)	1122
Marble	1125
Limestone	1125
Sandstone	1129
Miscellaneous stone	1129
Markets	1132
Technologic developments	1133
Foreign trade	1133

GENERAL SUMMARY

OUTPUT of crushed and dimension stone combined (178,852,360 tons) was 17 percent greater in 1946 than in 1945 and 9 percent less than the record attained in 1942. The total value ($234,339,486) increased 31 percent. The tonnage of crushed and broken stone was 16 percent greater than in 1945, and the value 25 percent. Dimension stone increased 30 percent in quantity and 85 in value. In common with the general trend of prices, average unit values were higher for virtually all classes of stone products. However, it is worthy of note that prices of crushed stone have increased less than have those of many other construction materials.

The tables of this report give the quantities sold or used by producers and the values f. o. b. quarries and mills. Stone quarried and used by producers is considered as sold and is included in the statistics of sales. The data, however, do not include stone made into abrasives (such as grindstones) or that used in making lime and cement. These materials are reported in terms of finished products in the Abrasive Materials, Lime, and Cement chapters of this volume. The following tables show the total sales of stone by kinds, uses, and States.

Stone sold or used by producers in the United States, 1942–46, by kinds

[Quantities approximate]

Year	Granite		Basalt and related rocks (trap rock)		Marble		Limestone	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1942	14,064,780	$23,794,514	17,626,660	$21,005,943	169,500	$3,910,203	142,487,600	$138,578,027
1943	9,240,280	18,217,064	14,385,260	17,699,907	168,790	3,610,035	128,980,270	127,296,872
1944	7,395,390	17,200,247	14,043,290	17,158,774	152,710	4,374,722	115,506,130	118,550,317
1945	7,740,030	17,052,764	14,910,540	17,532,775	171,230	5,284,827	112,574,420	121,441,509
1946	11,119,490	29,492,076	16,400,120	20,683,202	205,260	7,919,979	134,717,410	155,649,197

Year	Sandstone		Other stone [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1942	6,700,920	$8,620,453	14,835,030	$9,092,879	195,884,490	$205,002,019
1943	7,408,230	11,071,258	11,160,420	6,424,898	171,343,250	184,320,034
1944	6,426,670	10,985,211	12,055,390	7,372,886	155,579,580	175,642,157
1945	4,386,990	8,712,045	13,622,000	9,283,982	153,405,210	179,307,902
1946	4,253,860	11,407,302	12,156,220	9,187,730	178,852,360	234,339,486

[1] Includes mica schist, conglomerate, argillite, various light-color volcanic rocks, serpentine not used as marble, soapstone sold as dimension stone, and such other stone as cannot properly be classed in any principal group.

Stone sold or used by producers in the United States, 1945–46, by uses

Use	1945		1946	
	Quantity	Value	Quantity	Value
Dimension stone:				
Building stone:				
Rough construction, short tons	155,750	$926,402	208,170	$1,578,668
Cut stone, slabs, and mill blocks, cubic feet	3,038,120	4,558,609	6,654,340	12,189,205
Approximate equivalent in short tons	225,870		499,050	
Rubble, short tons	390,430	548,645	293,430	649,604
Monumental stone, cubic feet	3,038,870	11,360,627	3,677,920	17,434,556
Approximate equivalent in short tons	250,850		300,070	
Paving blocks, number	212,570	22,336	578,750	50,346
Approximate equivalent in short tons	1,560		5,270	
Curbing, cubic feet	158,260	203,797	374,900	544,477
Approximate equivalent in short tons	12,760		30,460	
Flagging, cubic feet	268,480	228,222	475,620	525,364
Approximate equivalent in short tons	21,470		38,130	
Total dimension stone (quantities approximate, in short tons)	1,058,690	17,848,638	1,374,580	32,972,220
Crushed and broken stone:				
Riprap, short tons	4,801,170	5,589,584	3,847,550	5,010,207
Crushed stone, do	85,373,260	80,429,619	107,267,250	110,892,504
Furnace flux (limestone), do	27,639,520	22,076,393	25,157,760	20,791,833
Refractory stone [1], do	2,526,650	4,545,339	2,088,080	4,157,179
Agricultural (limestone), do	17,395,570	25,892,317	22,781,750	32,482,907
Other uses, do	14,610,350	22,926,012	16,335,390	28,032,636
Total crushed and broken stone, do	152,346,520	161,459,264	177,477,780	201,367,266
Grand total (quantities approximate, in short tons)	153,405,210	179,307,902	178,852,360	234,339,486

[1] Ganister (sandstone), mica schist, soapstone, and dolomite.

Stone sold or used by noncommercial producers in the United States, 1945–46, by uses

[Included in total production]

Use	1945		1946	
	Short tons	Value	Short tons	Value
Building stone	59,490	$72,634	34,240	$174,029
Rubble	209,610	219,972	38,540	48,776
Flagging			2	20
Riprap	1,443,830	1,866,197	769,620	908,940
Crushed stone	4,760,970	5,317,471	6,479,220	7,940,772
Agricultural (limestone)	326,560	479,461	479,710	630,282
Other uses	468,580	812,889	112,630	162,299
	7,269,040	8,768,624	7,913,962	9,865,118

Stone sold or used by producers in the United States, 1945–46, by States

State	1945		1946	
	Short tons (approximate)	Value	Short tons (approximate)	Value
Alabama	2,238,740	$3,326,753	1,874,330	$3,385,892
Alaska	(1)	(1)	(1)	(1)
Arizona	404,170	376,200	[2] 191,430	[2] 269,279
Arkansas	[2] 932,320	[2] 926,763	995,720	1,135,856
California	9,636,810	8,554,461	[2] 8,950,320	[2] 8,452,083
Colorado	671,620	923,797	612,000	878,606
Connecticut	817,670	1,166,288	1,324,160	1,878,793
Delaware			23,070	57,662
Florida	[2] 2,617,180	[2] 3,024,465	[2] 2,863,070	[2] 3,212,135
Georgia	[2] 1,514,710	[2] 4,799,320	2,417,340	8,538,435
Hawaii	1,639,820	2,433,566	763,920	1,195,265
Idaho	247,140	293,980	548,870	568,159
Illinois	10,950,940	11,384,625	15,635,470	16,891,933
Indiana	4,187,110	6,293,019	5,767,430	9,950,338
Iowa	[2] 4,026,460	[2] 5,306,299	5,162,540	6,646,273
Kansas	[2] 3,666,000	[2] 2,847,200	3,653,640	3,908,588
Kentucky	[2] 3,470,770	[2] 3,740,716	[2] 4,745,560	[2] 5,205,820
Louisiana	1,000,040	756,341	(1)	(1)
Maine	[2] 112,920	[2] 382,414	[2] 147,680	[2] 927,588
Maryland	[2] 1,242,930	[2] 1,851,828	[2] 1,715,120	[2] 2,622,618
Massachusetts	1,283,310	2,393,390	[2] 1,976,180	[2] 4,135,238
Michigan	[2] 15,493,790	[2] 9,027,267	15,432,320	9,971,003
Minnesota	1,173,800	1,962,394	[2] 1,286,800	3,700,535
Mississippi	(1)	(1)	(1)	(1)
Missouri	[2] 5,314,160	[2] 6,055,747	7,258,990	8,996,440
Montana	646,850	563,374	441,480	440,046
Nebraska	297,750	622,671	263,930	612,120
Nevada	104,180	151,673	[2] 87,810	[2] 122,940
New Hampshire	3,760	93,089	68,530	385,828
New Jersey	[2] 2,261,750	[2] 3,498,182	3,419,210	5,239,342
New Mexico	361,700	173,120	(1)	(1)
New York	7,900,560	9,133,781	9,939,440	12,086,748
North Carolina	[2] 2,297,670	[2] 2,965,458	4,505,880	6,835,448
Ohio	[2] 13,279,800	[2] 13,966,710	[2] 16,991,440	[2] 19,069,169
Oklahoma	3,894,720	1,572,772	3,413,430	2,624,579
Oregon	[2] 1,498,160	[2] 1,898,073	[2] 1,472,700	[2] 2,008,374
Pennsylvania	[2] 17,708,390	[2] 22,266,706	18,883,740	25,872,596
Puerto Rico	271,150	342,606	155,860	290,722
Rhode Island	[2] 11,280	[2] 219,263	[2] 4,860	[2] 274,130
South Carolina	[2] 1,380,800	[2] 2,041,202	1,979,270	2,990,678
South Dakota	[2] 303,500	[2] 1,605,904	379,880	2,385,543
Tennessee	4,772,720	6,318,915	5,156,490	7,625,086
Texas	2,798,580	2,726,659	3,285,220	3,611,118
Utah	[2] 215,400	[2] 318,254	404,370	591,940
Vermont	173,120	4,538,557	230,400	6,740,160
Virginia	5,445,900	6,689,809	7,873,020	9,754,482
Washington	[2] 3,741,250	[2] 3,773,096	[2] 3,149,900	[2] 3,232,805
West Virginia	3,670,700	3,989,534	[2] 4,131,540	[2] 4,464,048
Wisconsin	4,764,180	8,442,921	6,193,400	11,473,119
Wyoming	1,551,220	1,321,415	1,204,570	1,203,636
Undistributed	1,407,710	2,247,325	1,870,030	1,936,290
	153,405,210	179,307,902	178,852,360	234,339,486

[1] Included under "Undistributed."

[2] To avoid disclosing confidential information, certain State totals are incomplete, the figures not included being combined under "Undistributed."

DIMENSION STONE

The term "dimension stone" is applied to blocks or slabs of natural stone, most of which are cut to definite shapes and sizes. These products are distinct from crushed and broken stone, which comprises irregular fragments or grains sized chiefly by mechanical screening or air separation. Crushed and broken stone is covered in a later section of this chapter.

Dimension-stone producers may be divided into three main groups upon the basis of plant operation. The first group includes operators who quarry stone and sell it as rough blocks or slabs; the second group quarries stone and also manufactures it into finished products; and the third buys sawed slabs or rough blocks of stone and manufactures them into finished products but does not operate quarries. The Bureau of Mines statistical canvass covers the first and second groups, but as the third group comprises manufacturers rather than quarrymen it is canvassed only by the Bureau of the Census. Bureau of Mines statistics are compiled from reports of quantities and values of original sales; hence they include some material sold as rough blocks and some sold as finished products.

Total sales of dimension stone in 1946 increased 30 percent in quantity and 84 percent in value compared with 1945. These over-all figures include slate, but detailed statistics of this branch of the industry are given in the separate chapter on Slate.

The accompanying table presents salient statistics for 1945 and 1946.

Dimension stone sold or used by producers in the United States, 1945–46, by kinds and uses

Kind and use	1945	1946	
		Total	Percent of change
Granite:			
Building stone:			
Rough construction—short tons	15,220	69,750	+358
Value	$56,314	$380,338	+575
Average per ton	$3.70	$5.45	+47
Cut stone, slabs, and mill blocks—cubic feet	151,250	538,810	+256
Value	$328,366	$2,127,124	+548
Average per cubic foot	$2.17	$3.95	+82
Rubble—short tons	108,880	130,820	+20
Value	$192,107	$263,054	+37
Monumental stone—cubic feet	2,600,760	3,194,740	+23
Value	$8,228,343	$13,433,094	+63
Average per cubic foot	$3.16	$4.20	+33
Paving blocks—number	212,570	578,750	+172
Value	$22,336	$50,346	+125
Curbing—cubic feet	119,270	314,540	+164
Value	$153,819	$458,312	+198
Total:			
Quantity—approximate short tons	361,650	535,230	+48
Value	$8,981,285	$16,712,268	+86
Basalt and related rocks (trap rock):			
Building stone:			
Rough construction—short tons	7,470	20,470	+174
Value	$19,702	$53,237	+170
Average per ton	$2.64	$2.60	−2
Rubble—short tons	196,050	29,460	−85
Value	$210,693	$17,232	−92
Total:			
Quantity—short tons	203,520	49,930	−75
Value	$230,395	$70,469	−69

Dimension stone sold or used by producers in the United States, 1945–46, by kinds and uses—Continued

Kind and use	1945	1946	
		Total	Percent of change
Marble:			
Building stone (cut stone, slabs, and mill blocks)—cubic feet	265,500	422,880	+59
Value	$1,573,148	$3,079,553	+96
Average per cubic foot	$5.93	$7.28	+23
Monumental stone—cubic feet	438,110	483,180	+10
Value	$3,132,284	$4,001,462	+28
Average per cubic foot	$7.15	$8.28	+16
Total:			
Quantity—approximate short tons	59,690	77,010	+29
Value	$4,705,432	$7,081,015	+50
Limestone:			
Building stone:			
Rough construction—short tons	92,090	57,670	−37
Value	$138,825	$147,420	+6
Average per ton	$1.51	$2.56	+70
Cut stone, slabs, and mill blocks—cubic feet	2,298,140	4,678,050	+104
Value	$2,267,501	$5,516,423	+143
Average per cubic foot	$0.99	$1.18	+19
Rubble—short tons	69,780	95,020	+36
Value	$73,413	$170,832	+133
Flagging—cubic feet	65,060	90,240	+39
Value	$25,272	$44,229	+75
Total:			
Quantity—approximate short tons	334,480	504,070	+51
Value	$2,505,011	$5,878,904	+135
Sandstone:			
Building stone:			
Rough construction—short tons	9,220	24,880	+170
Value	$35,276	$134,644	+282
Average per ton	$3.83	$5.41	+41
Cut stone, slabs, and mill blocks—cubic feet	323,230	1,014,600	+214
Value	$389,594	$1,466,105	+276
Average per cubic foot	$1.21	$1.45	+20
Rubble—short tons	13,150	27,940	+112
Value	$65,051	$176,994	+172
Curbing—cubic feet	38,990	60,360	+55
Value	$49,978	$86,165	+72
Flagging—cubic feet	194,130	363,620	+87
Value	$197,051	$463,170	+135
Total:			
Quantity—approximate short tons	64,240	160,900	+150
Value	$736,950	$2,327,078	+216
Miscellaneous stone: [1]			
Building stone—cubic feet	373,530	416,470	+11
Value	$676,285	$863,029	+28
Average per cubic foot	$1.81	$2.07	+14
Rubble—short tons	2,570	10,190	+296
Value	$7,381	$21,492	+191
Flagging—cubic feet	9,290	21,760	+134
Value	$5,899	$17,965	+205
Total:			
Quantity—approximate short tons	35,110	47,440	+35
Value	$689,565	$902,486	+31
Total dimension stone, excluding slate:			
Quantity—approximate short tons	1,058,690	1,374,580	+30
Value	$17,848,638	$32,972,220	+85
Slate as dimension stone [2]—approximate short tons	69,660	96,250	+38
Value	$1,971,740	$3,419,502	+73
Total dimension stone, including slate:			
Quantity—approximate short tons	1,128,350	1,470,830	+30
Value	$19,820,378	$36,391,722	+84

[1] Includes soapstone, mica schist, volcanic rocks, argillite, and other varieties that cannot be classified in the principal groups.

[2] Details of production, by uses, are given in the Slate chapter of this volume.

BUILDING STONE

The largest use of dimension stone is for building. During the war the output of dimension stone declined to a record low in 1944. However, demand improved in the following year, and in 1946 output increased 87 percent in quantity and 151 percent in value as compared with 1945. The following table gives the quantity and value of the major types of building stone used in 1946.

Building stone sold or used by producers in the United States in 1946, by kinds

Kind	Rough				Finished				Total	
	Construction		Architectural		Sawed		Cut			
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
Granite	838,420	$380,338	143,840	$156,821	253,190	$654,453	141,780	$1,315,850	1,377,230	$2,507,462
Basalt	242,990	53,237							242,990	53,237
Marble			107,500	277,123	101,890	531,408	213,490	2,271,022	422,880	3,079,553
Limestone	700,640	147,420	2,596,340	1,843,624	1,487,950	1,607,584	593,760	2,065,215	5,378,690	5,663,843
Sandstone	313,530	134,644	102,910	66,864	855,600	1,217,677	56,090	181,564	1,328,130	1,600,749
Miscellaneous	416,470	863,029							416,470	863,029
	2,512,050	1,578,668	2,950,590	2,344,432	2,698,630	4,011,122	1,005,120	5,833,651	9,166,390	13,767,873

[1] Sawed stone corresponds to dressed stone for construction work (walls, foundations, bridges) and cut stone to architectural stone for high-class buildings.

GRANITE

Sales of granite in the form of blocks and slabs gained 48 percent in quantity and 86 percent in value in 1946 compared with 1945. The greatest gains were in the building-stone branch of the industry, rough construction stone sales gaining 358 percent and cut stone 256 percent in quantity compared with 1945. Monumental stone gained 23 percent in quantity and 63 percent in value. Paving block and curbing sales were more than two and one-half times as great as in 1945. Unit prices were higher in all but one of the important categories—that of rough architectural stone. The unit value of paving blocks—now a minor product of the industry— was also lower. Details by States are indicated in the following table.

Granite (dimension stone) sold or used by producers in the United States in 1946, by States and uses

State	Active plants	Building								Monumental				Paving blocks		Curbing		Total	
		Rough				Dressed		Rubble		Rough		Dressed							
		Construction		Architectural										Number	Value	Cubic feet	Value	Short tons (approximate)	Value
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Cubic feet	Value	Cubic feet	Value						
California	13	(1)	(1)	(1)	(1)	-------	-------	1,510	$11,571	32,660	$95,814	(1)	(1)	-------	-------	(1)	(1)	6,210	$271,239
Colorado	4	-------	-------	-------	-------	-------	-------	-------	-------	4,180	9,590	20	$240	-------	-------	-------	-------	350	9,830
Connecticut	5	-------	-------	3,060	$4,302	4,730	$17,765	(1)	(1)	4,590	22,401	(1)	(1)	-------	-------	(1)	(1)	2,630	119,937
Georgia	15	22,870	$81,957	-------	-------	1,830	10,002	20,510	41,775	730,260	1,596,885	136,160	945,216	56,150	$3,110	82,270	$94,940	122,830	2,773,885
Maine	10	-------	-------	16,520	21,056	87,320	407,222	970	3,465	22,850	51,923	10,260	92,102	165,000	21,450	6,420	5,663	14,520	602,881
Maryland	5	9,440	54,062	(1)	(1)	-------	-------	(1)	(1)	-------	-------	-------	-------	-------	-------	(1)	(1)	54,010	171,494
Massachusetts	7	(1)	(1)	14,020	30,182	(1)	(1)	3,310	26,851	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	31,490	1,147,748
Minnesota	18	-------	-------	(1)	(1)	(1)	(1)	-------	-------	164,880	301,307	116,700	1,087,400	-------	-------	-------	-------	25,830	1,851,780
Missouri	2	-------	-------	-------	-------	-------	-------	(1)	(1)	(1)	(1)	-------	-------	-------	-------	-------	-------	(1)	(1)
Montana	3	-------	-------	-------	-------	-------	-------	-------	-------	(1)	(1)	(1)	(1)	-------	-------	-------	-------	160	10,730
New Hampshire	3	230	450	3,450	7,700	11,700	113,346	-------	-------	6,800	30,350	17,150	139,898	-------	-------	810	1,462	3,520	293,206
New York	3	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	-------	-------	(1)	(1)	(1)	(1)	-------	-------	10,020	81,788
North Carolina	6	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	26,210	60,322	(1)	(1)	(1)	(1)	(1)	(1)	29,130	646,142
Oklahoma	8	-------	-------	(1)	(1)	-------	-------	(1)	(1)	74,800	228,605	(1)	(1)	-------	-------	(1)	(1)	7,930	394,431
Oregon	1	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	(1)	(1)	-------	-------	-------	-------	(1)	(1)
Pennsylvania	8	28,050	183,105	(1)	(1)	-------	-------	21,120	41,508	(1)	(1)	20,430	161,534	29,850	1,516	-------	-------	53,030	428,113
Rhode Island	2	-------	-------	-------	-------	-------	-------	-------	-------	46,450	266,786	-------	-------	-------	-------	-------	-------	380	266,786
South Carolina	3	450	1,536	120	119	-------	-------	(1)	(1)	(1)	(1)	-------	-------	21,150	1,258	(1)	(1)	23,760	622,741
South Dakota	6	-------	-------	-------	-------	(1)	(1)	-------	-------	(1)	(1)	154,900	1,565,171	-------	-------	-------	-------	17,160	1,824,386
Texas	5	-------	-------	-------	-------	-------	-------	5,000	2,500	12,630	40,172	10,000	100,000	-------	-------	-------	-------	6,870	142,672
Vermont	6	-------	-------	(1)	(1)	-------	-------	-------	-------	(1)	(1)	-------	-------	-------	-------	-------	-------	82,470	3,527,801
Virginia	2	-------	-------	-------	-------	-------	-------	(1)	(1)	(1)	(1)	(1)	(1)	-------	-------	-------	-------	(1)	(1)
Washington	4	-------	-------	(1)	(1)	2,400	19,200	(1)	(1)	(1)	(1)	-------	-------	-------	-------	-------	-------	13,390	29,355
Wisconsin	11	(1)	(1)	-------	-------	(1)	(1)	-------	-------	19,330	58,013	74,100	1,163,900	(1)	(1)	(1)	(1)	8,420	1,308,777
Wyoming	1	-------	-------	-------	-------	-------	-------	(1)	(1)	-------	-------	-------	-------	-------	-------	-------	-------	(1)	(1)
Undistributed	-------	8,710	59,228	106,670	93,462	286,990	1,402,768	78,400	135,384	1,422,510	4,514,476	86,870	900,989	306,600	23,012	225,040	356,247	21,120	186,546
	151	69,750	380,338	143,840	156,821	394,970	1,970,303	130,820	263,054	2,568,150	7,276,644	626,590	6,156,450	578,750	50,346	314,540	458,312	535,230	16,712,268
Average unit value	-------	-------	$5.45	-------	$1.09	-------	$4.99	-------	$2.01	---------	$2.83	-------	$9.83	-------	$0.09	--------	$1.46	--------	$31.22
Short tons (approximate)	-------	(2)	-------	11,830	-------	32,610	---------	-------	-------	207,360	---------	51,620	---------	5,270	-------	25,970	-------	---------	---------

[1] Included under "Undistributed."
[2] 838,420 cubic feet (approximate).

The following tables show sales of monumental granite in the Barre district, Vermont.

Monumental granite sold by quarrymen in the Barre district, Vermont, 1942–46 [1]

Year	Cubic feet	Value	Year	Cubic feet	Value
1942	612,220	$2,035,327	1945	713,050	$2,308,506
1943	635,350	2,267,777	1946	990,156	3,461,801
1944	733,500	2,553,681			

[1] Barre granite is sold also for construction and crushed stone.

Estimated output of monumental granite in the Barre district, Vermont, 1944–46 [1]

	1944	1945	1946
Total quarry output, rough stock—cubic feet	613,308	716,089	982,692
Shipped out of Barre district in rough—do	122,661	143,217	196,538
Manufactured in Barre district—do	490,647	572,872	786,154
Light stock consumed in district—do	383,319	477,393	524,103
Dark stock consumed in district—do	229,989	238,696	262,051
Number of cutters in district	1,200	1,318	1,500
Average daily wage	$10.00	$10.50	$11.00
Average number of days worked	244	250	250
Total pay roll for year	$2,928,000	$3,459,750	$4,125,000
Estimated overhead	1,464,000	1,729,875	2,062,500
Estimated value of light stock	1,494,934	1,862,833	2,718,781
Estimated value of dark stock	1,069,449	1,109,936	1,621,442
Estimated polishing cost	129,347	1,441,128	2,236,418
Estimated sawing cost	388,038	1,127,839	1,750,240
Total value of granite	7,473,768	10,731,361	14,514,381

[1] Through the kindness of the Granite Manufacturers' Association, Barre, figures covering the entire granite industry of the Barre district are given in this table to supplement figures of sales reported by quarrymen.

BASALT AND RELATED ROCKS (TRAP ROCK)

Owing to their dark color, basalt and related rocks are not used extensively as building stone. Sales in 1946 for rough construction were higher than in 1945, but sales of rubble—a crude form of building stone—declined greatly. Basalt and related rocks are used to some extent for memorials, but such stones are classed in trade as black granite and are therefore included with the figures for monumental granite.

Basalt and related rocks (trap rock) (dimension stone) sold or used by producers in the United States in 1946, by States and uses

State	Active plants	Building stone				Total	
		Rough construction		Rubble		Short tons	Value
		Short tons	Value	Short tons	Value		
Colorado	1			(1)	(1)	(1)	(1)
Connecticut	1	(1)	(1)			(1)	(1)
Hawaii	1	(1)	(1)	(1)	(1)	31,500	$20,205
Montana	1			(1)	(1)	(1)	(1)
New Jersey	1			(1)	(1)	(1)	(1)
Oregon	1	(1)	(1)			(1)	(1)
Pennsylvania	1	15,730	$37,400			15,730	37,400
Undistributed		4,740	15,837	29,460	$17,232	2,700	12,864
	7	[2] 20,470	53,237	29,460	17,232	49,930	70,469
Average unit value			$2.60		$0.58		$1.41

[1] Included under "Undistributed."
[2] 242,990 cubic feet (approximate).

MARBLE

In 1946, sales of marble increased 29 percent in quantity and 50 percent in value compared with 1945. The marble industry is beginning to benefit from the rise in construction of large permanent public and private buildings. Although the emphasis of the building industry in 1946 was on residential construction, sales of building marble increased 59 percent in quantity and 96 percent in value. As a large potential demand for buildings that customarily are built partly of marble has accumulated during the past 15 years, further increases are expected.

Sales of monumental marble rose 10 percent in quantity and 28 percent in value in 1946.

Marble (dimension stone) sold by producers in the United States, 1945–46, by uses

Use	1945		1946	
	Cubic feet	Value	Cubic feet	Value
Building stone:				
Rough:				
Exterior	24,710	$42,114	9,170	$31,653
Interior [1]	59,420	132,857	98,330	245,470
Finished:				
Exterior	33,990	157,413	87,670	535,100
Interior	147,380	1,240,764	227,710	2,267,330
Total exterior	58,700	199,527	96,840	566,753
Total interior	206,800	1,373,621	326,040	2,512,800
Total building stone	265,500	1,573,148	422,880	3,079,553
Monumental stone:				
Rough				
Finished	438,110	3,132,284	483,180	4,001,462
Total monumental stone	438,110	3,132,284	483,180	4,001,462
Total building and monumental	703,610	4,705,432	906,060	7,081,015
Approximate short tons	59,690		77,010	

[1] Includes onyx for the manufacture of mantels, lamp bases, desk sets, clock cases, and novelties.

Marble (dimension stone) sold by producers in the United States in 1946, by States and uses

State	Active plants	Building		Monumental		Total		
						Quantity		
		Cubic feet	Value	Cubic feet	Value	Cubic feet	Short tons (approximate)	Value
Alabama	2	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Arkansas	.1	8,300	$30,750	1,500	$7,500	9,800	830	$38,250
Georgia	1	41,920	326,112	254,300	1,946,690	296,220	25,180	2,272,802
Maryland	1	5,600	40,548			5,600	480	40,548
Minnesota	1	1,100	13,800			1,100	80	13,800
Missouri	3	54,450	309,967	10,610	41,718	65,060	5,530	351,685
North Carolina	1			(1)	(1)	(1)	(1)	(1)
Tennessee	5	(1)	(1)	(1)	(1)	192,790	16,390	1,411,915
Utah [2]	1	6,800	24,748			6,800	580	24,748
Vermont	5	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Undistributed		304,710	2,333,628	216,770	2,005,554	328,690	27,940	2,927,267
	21	422,880	3,079,553	483,180	4,001,462	906,060	77,010	7,081,015
Average unit value			$7.28		$8.28			[3] $7.82
Short tons (approximate)		35,920		41,090				

[1] Included under "Undistributed."
[2] Figures represent onyx rough blocks for the manufacture of mantels, lamp bases, desk sets, clock cases, and novelties.
[3] Average value per cubic foot.

LIMESTONE

Although equivalent to only about half the prewar tonnage and 27 percent of the 1929 value, the output of limestone, in the form of dimension stone, in 1946 was recovering steadily from the wartime lows. Less rough construction stone was reported than in 1945, but all other classes showed substantial gains in tonnage and value.

Production of cut stone was more than twice as great and the value per cubic foot was 19 percent higher than in 1945. Rubble gained 36 percent in tonnage. The total quantity of building limestone sold in 1946 was more than one and one-half times that of 1945, and the sales value was more than two and one-third times as great. See details in accompanying table.

The area in the United States most productive of dimension limestone is in the vicinity of Bedford and Bloomington, Ind. This area supplied 80 percent of the rough architectural and finished (sawed and cut) limestone sold in 1946.

The following tables show production in the Bedford-Bloomington, Ind., and Carthage, Mo., areas over a 5-year period.

Limestone sold by producers in the Indiana oolitic limestone district, 1942–46, by classes

Year	Construction					
	Rough block		Sawed and semifinished		Cut	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
1942	526,620	$160,117	135,360	$98,519	766,320	$1,070,164
1943	288,750	94,500	135,580	92,034	141,200	211,019
1944	339,090	133,829	[1] 254,060	[1] 222,354	(1)	(1)
1945	955,320	434,173	739,080	571,799	401,330	1,023,744
1946	1,930,710	1,143,664	1,340,930	1,411,831	453,010	1,460,305

Year	Construction—Continued			Other uses		Total	
	Total						
	Cubic feet	Short tons (approximate)	Value	Short tons	Value	Short tons (approximate)	Value
1942	1,428,300	103,500	$1,328,800	87,770	$69,404	191,270	$1,398,204
1943	565,530	41,000	397,553	150,710	181,303	191,710	578,856
1944	593,150	43,000	356,183	16,380	13,690	59,380	369,873
1945	2,095,730	152,000	2,029,716	24,880	23,850	176,880	2,053,566
1946	3,724,650	270,040	4,015,800	77,550	45,144	347,590	4,060,944

[1] Cut stone is included with sawed and semifinished stone.

Limestone (dimension stone) sold or used by producers in the United States in 1946, by States and uses

State	Active plants	Building								Flagging		Total	
		Rough				Finished (cut and sawed)		Rubble					
		Construction		Architectural									
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Cubic feet	Value	Short tons (approximate)	Value
Alabama	3	(1)	(1)	(1)	(1)	(1)	(1)					(1)	(1)
California	5	(1)	(1)	(1)	(1)			690	$1,162	(1)	(1)	2,230	$8,748
Colorado	1					8,550	$25,662					680	25,662
Florida	1					(1)	(1)					(1)	(1)
Illinois	8	1,360	$1,603					12,200	20,434	10,110	$2,731	14,420	24,768
Indiana	21			1,930,710	$1,143,664	1,793,940	2,872,136	(1)	(1)	(1)	(1)	270,570	4,016,304
Iowa	2							1,190	2,772	1,090	468	1,280	3,240
Kansas	15	9,400	19,428	28,920	19,958	107,620	140,888	3,930	7,209	1,670	1,806	25,080	189,289
Kentucky	3	(1)	(1)					(1)	(1)			270	378
Michigan	1			(1)	(1)							(1)	(1)
Minnesota	7	7,460	12,988	128,320	130,958	40,400	207,500	1,810	5,153	2,790	3,050	22,990	359,649
Missouri	11	1,120	1,980					21,480	76,830	6,210	4,388	23,130	83,198
New Mexico	1	(1)	(1)									(1)	(1)
New York	2	(1)	(1)					(1)	(1)			(1)	(1)
Ohio	2	(1)	(1)					(1)	(1)			(1)	(1)
Pennsylvania	10	19,710	35,625					(1)	(1)	(1)	(1)	21,030	37,393
Puerto Rico	6	2,850	4,550					9,570	11,899			12,420	16,449
South Dakota	1									4,830	1,544	390	1,544
Tennessee	1	(1)	(1)					(1)	(1)			(1)	(1)
Texas	7			264,090	237,617	(1)	(1)	(1)	(1)			52,640	574,522
Vermont	1							(1)	(1)			(1)	(1)
Virginia	2	(1)	(1)									(1)	(1)
Wisconsin	13	8,260	48,172	220,540	290,667	1,140	3,852	8,100	18,696	56,660	27,435	38,630	388,822
Wyoming	1	(1)	(1)									(1)	(1)
Undistributed		7,510	23,074	23,760	20,760	130,060	422,761	36,050	26,677	6,880	2,807	18,310	148,938
	125	57,670	147,420	2,596,340	1,843,624	2,081,710	3,672,799	95,020	170,832	90,240	44,229	504,070	5,878,904
Average unit value			$2.56		$0.71		$1.76		$1.80		$0.49		$11.66
Short tons (approximate)		(2)		191,360		152,730				7,290			

[1] Included under "Undistributed." [2] 700,640 cubic feet (approximate).

Purchased Indiana limestone sold by mills in the Indiana oolitic limestone district, 1942–46, by classes

Year	Sawed and semifinished		Cut		Total	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
1942	[1] 54,680	[1] $17,128	[1] 449,950	[1] $746,312	504,630	$763,440
1943	(1)	(1)	[1] 232,700	[1] 362,757	232,700	362,757
1944	(1)	(1)	[1] 287,130	[1] 529,391	287,130	529,391
1945	10,840	6,454	278,820	798,372	289,660	804,826
1946	42,360	44,200	590,320	1,972,265	632,680	2,016,465

[1] A small quantity of sawed and semifinished stone included with cut stone.

Limestone and marble sold by producers in the Carthage district, Jasper County, Mo., 1942–46, by classes

Year	Dimension stone (rough and dressed)							Other uses		Total	
	Building		Monumental		Total						
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Short tons (approximate)	Value	Short tons	Value	Short tons (approximate)	Value
1942	22,580	$100,581	9,590	$23,271	32,170	2,650	$123,852	436,600	$538,697	439,250	$662,549
1943	11,950	66,326	10,910	33,532	22,860	1,910	99,858	299,730	487,519	301,640	587,377
1944	14,180	94,338	14,680	58,632	28,860	2,420	152,970	218,190	476,750	220,610	629,720
1945	30,230	211,299	14,150	64,900	44,380	3,660	276,199	223,160	444,518	226,820	720,717
1946	49,190	289,866	10,610	41,718	59,800	5,080	331,584	265,260	550,998	270,340	882,582

SANDSTONE

The output of sandstone for use as dimension stone by the construction industry increased greatly in 1946. Sales of cut stone, slabs, and mill blocks gained 214 percent in quantity and 276 percent in value. Sandstone for rough construction, rubble, curbing, and flagging also gained in quantity and value. No production of paving stones was reported. The total quantity of sandstone sold in 1946 was two and one-half times that in 1945, and its value had more than tripled.

As in previous years, Ohio was the principal producer. Its quarries produced 61 percent of the total value of output in 1946. Other producing States, in order of sales value, were New York, Tennessee, Pennsylvania, and West Virginia.

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Sandstone (dimension stone) sold or used by producers in the United States in 1946, by States and uses

State	Active plants	Building								Rubble		Curbing		Flagging		Total	
		Rough construction		Rough architectural		Dressed											
						Sawed		Cut									
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons (approximate)	Value
Arizona	1	(1)	(1)											(1)	(1)	(1)	(1)
Arkansas	1	(1)	(1)													(1)	(1)
California	7	1,550	$10,555	(1)	(1)					1,690	$5,075	(1)	(1)	(1)	(1)	3,950	$26,939
Colorado	3	(1)	(1)			640	$1,300			(1)	(1)			830	$1,000	2,130	10,685
Georgia	1									(1)	(1)			(1)	(1)	(1)	(1)
Illinois	1									(1)	(1)					(1)	(1)
Indiana	1			(1)	(1)											(1)	(1)
Kansas	3	(1)	(1)	(1)	(1)					(1)	(1)			(1)	(1)	920	7,813
New York [2]	10	(1)	(1)	(1)	(1)	1,750	7,000	2,350	$16,000	(1)	(1)	14,460	$22,547	155,130	160,410	20,840	246,582
Ohio	7	(1)	(1)	23,430	$16,792	817,340	1,150,749	(1)	(1)			44,200	62,549	108,300	154,373	73,640	1,429,686
Oklahoma	1									(1)	(1)					(1)	(1)
Pennsylvania [3]	19	12,860	77,928	(1)	(1)	(1)	(1)			14,240	39,553	(1)	(1)	43,620	54,461	31,750	177,734
Tennessee	2	(1)	(1)							(1)	(1)			(1)	(1)	(1)	(1)
Virginia	3	(1)	(1)											(1)	(1)	820	3,824
Washington	1					(1)	(1)	(1)	(1)							(1)	(1)
West Virginia	2	(1)	(1)					(1)	(1)	(1)	(1)					(1)	(1)
Wisconsin	4			(1)	(1)	(1)	(1)	(1)	(1)					(1)	(1)	(1)	(1)
Undistributed		10,470	46,161	79,480	50,072	35,870	58,628	53,740	165,564	12,010	132,366	1,700	1,069	55,740	92,926	26,850	423,815
	67	24,880	134,644	102,910	66,864	855,600	1,217,677	56,090	181,564	27,940	176,994	60,360	86,165	363,620	463,170	160,900	2,327,078
Average unit value			$5.41		$0.65		$1.42		$3.24		$6.33		$1.43		$1.27		$14.46
Short tons (approximate)		[4]		7,910		62,340		4,350				4,490		28,990			

[1] Included under "Undistributed."
[2] Includes 186,030 cubic feet of bluestone (approximately 15,720 tons) valued at $203,619 sold for construction, curbing, and flagging.
[3] Includes 87,690 cubic feet of bluestone (approximately 7,410 tons) valued at $70,898 sold for construction, curbing, and flagging.
[4] 313,530 cubic feet (approximate).

The accompanying table presents the sales of bluestone 1942–46. Bluestone is a type of sandstone that splits readily into thin, uniform sheets. It is particularly well adapted for flagging but is used also for building stone and curbing. During the past 20 years the industry has declined greatly because concrete has won much of its market. However in 1946 bluestone output had regained its prewar level.

Bluestone (dimension stone) sold or used in the United States, 1942–46 [1]

Year	Cubic feet	Value	Year	Cubic feet	Value
1942	183,470	$166,787	1945	109,330	$89,448
1943	99,840	92,059	1946	273,720	274,517
1944	156,160	108,732			

[1] New York and Pennsylvania are the only States that produce bluestone.

MISCELLANEOUS STONE

Types of stone other than those included in the major groups already discussed are covered in the following table. The principal varieties are mica schist, argillite, light-color volcanic rocks, soapstone, and greenstone. The quantity sold in 1946 increased 35 percent and the value 31 percent compared with 1945.

Miscellaneous varieties of stone (dimension stone) sold or used by producers in the United States in 1946, by States and uses

State	Active plants	Building				Flagging		Total	
		Rough and dressed		Rubble					
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Arizona	3	(1)	(1)	(1)	(1)			1,840	$5,020
California	3	(1)	(1)	(1)	(1)	(1)	(1)	6,530	62,996
Georgia	2			(1)	(1)	(1)	(1)	(1)	(1)
Maryland	3	(1)	(1)	(1)	(1)	(1)	(1)	7,150	25,757
New Jersey	1	(1)	(1)					(1)	(1)
New York	1	200	$1,000					200	1,000
North Carolina	1	260	519					260	519
Pennsylvania	2	(1)	(1)	(1)	(1)			(1)	(1)
Puerto Rico	1			(1)	(1)			(1)	(1)
Virginia	2	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Undistributed		34,940	861,510	10,190	$21,492	1,850	$17,965	31,460	807,194
	19	[2] 35,400	863,029	10,190	21,492	[2] 1,850	17,965	47,440	902,486
Average unit value			$24.38		$2.11		$9.71		$19.02

[1] Included under "Undistributed."
[2] Building stone (rough and dressed), approximately 416,470 cubic feet; flagging, approximately 21,760 cubic feet.

TRENDS IN USE OF DIMENSION STONE

A 31-year history of the output of dimension stone by kinds is shown in figure 1. Since the 1920's, depression, war, and competition of other construction materials have kept demand at low levels. The curve was rising in 1946 and prospects were brighter than they had been in many years.

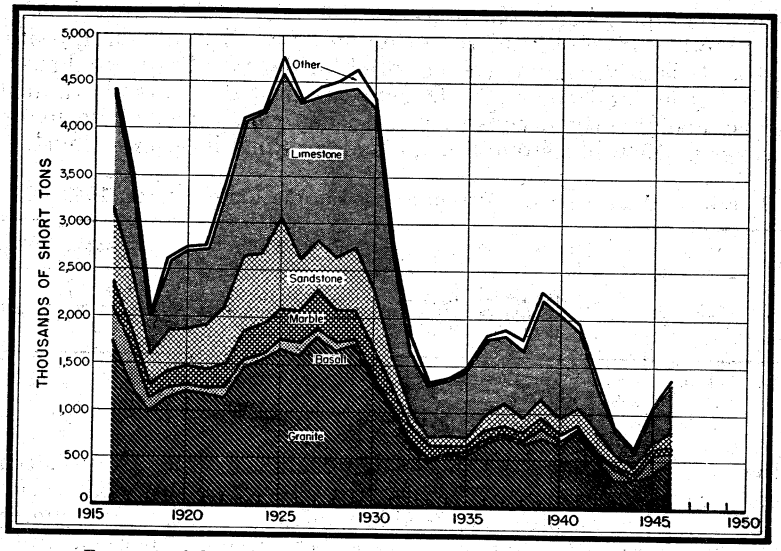

FIGURE 1.—Sales of dimension stone in the United States, by kinds, 1916–46.

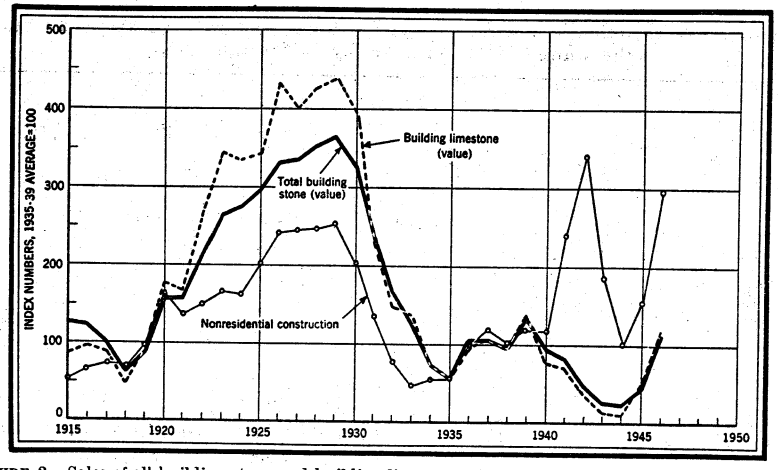

FIGURE 2.—Sales of all building stone and building limestone compared with nonresidential construction (public and private), 1915–46. Data on nonresidential building construction from Bureau of Foreign and Domestic Commerce.

Figure 2 traces for 32 years the history of production of all building stone and of the principal variety—limestone—in their relation to nonresidential building, the class of construction that normally uses stone most extensively. After a period of decline during the war years, when few buildings—either residential or nonresidential—of the substantial durable type that has dimension-stone components were built, the trend of demand is again up. There is a backlog of potential public and private nonresidential building construction that has been delayed owing to emphasis on the less expensive type of residential construction. The dimension-stone industry is expected to benefit from these building programs in the future.

TECHNOLOGIC DEVELOPMENTS

The wire saw has been used for many years for cutting the softer stones. It has been particularly successful in the slate industry, but it has not gained acceptance in granite quarrying. However, it is reported that in 1946 work was in progress on adaptation of the wire saw to cutting granite at Barre, Vermont, and the preliminary tests were encouraging.

For many years cast basalt has been produced on a small scale in Germany. The process and its commercial success has been described in a recent British pamphlet.[1] The basalt is melted at 1,200° to 1,500° C. over a 4- to 6-hour period, cast in cast-iron or sand molds, and annealed for about 60 hours at temperatures that start at 900° C. and decline to normal. The product is used as acid-resisting brick and pipe lining. The process is relatively expensive and has never attained great commercial success.

CRUSHED AND BROKEN STONE

Over 177 million short tons of crushed and broken stone were produced in 1946, exclusive of that used for making cement and lime. Output increased 16 percent in quantity and 25 percent in value. The principal gains were in the concrete and road metal and agricultural uses, whereas there were substantial declines in consumption of stone for ballast, metallurgy, riprap, and refractories. The average value at the quarry increased 7 cents a ton.

The accompanying table of salient statistics shows the quantity sold and the value of output during 1945 and 1946, by uses. Detailed data on asphaltic stone and slate granules and flour are given in the Asphalt and Slate chapters of this volume.

[1] Nicklin, R. J. P., Investigation of Cast Basalt: B. I. O. S. Final Report 949, Item 21, British Intelligence Objectives Subcommittee, 32 Bryanston Square, London W1, England, December 1946, 4 pp.

Crushed and broken stone sold or used by producers in the United States, 1945–46, by principal uses

Use	1945			1946		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Concrete and road metal	64,108,190	$65,535,403	$1.02	90,358,900	$97,765,446	$1.08
Railroad ballast	21,265,070	14,894,216	.70	16,908,350	13,127,058	.78
Metallurgical	27,639,520	22,076,393	.80	25,157,760	20,791,833	.83
Alkali works	7,076,330	4,068,060	.57	7,418,690	5,230,804	.71
Riprap	4,801,170	5,589,584	1.16	3,847,550	5,010,207	1.30
Agricultural	17,395,570	25,892,317	1.49	22,781,750	32,482,907	1.43
Refractory (ganister, mica schist, dolomite, soapstone)	2,526,650	4,545,339	1.80	2,088,080	4,157,179	1.99
Asphalt filler	455,360	971,570	2.13	459,020	1,270,734	2.77
Calcium carbide works	549,510	639,833	1.16	411,660	437,231	1.06
Sugar factories	[1] 340,310	[1] 691,922	[1] 2.03	378,720	693,058	1.83
Glass factories	[1] 556,610	[1] 937,615	[1] 1.68	648,250	1,163,161	1.79
Paper mills	352,990	620,943	1.76	385,620	685,912	1.78
Other uses	5,279,240	14,996,069	2.84	6,633,430	18,551,736	2.80
	152,346,520	161,459,264	1.06	177,477,780	201,367,266	1.13
Portland and natural cement and cement rock [2]	27,332,000	[3]		43,877,000	[3]	
Lime [4]	11,841,000	[3]		11,985,000	[3]	
Total stone	191,520,000	[3]		233,340,000	[3]	
Asphaltic stone	642,600	2,565,925	3.99	777,457	2,861,591	3.68
Slate granules and flour	482,230	3,687,173	7.65	663,520	5,424,604	8.18

[1] Revised figure.
[2] Value reported as cement in chapter on Cement.
[3] No value available for stone used in manufacture of cement and lime.
[4] Value reported as lime in chapter on Lime.

The following tables show the tonnage and value of stone used for concrete aggregate, road construction, and railroad ballast for a series of years and by States for 1946.

Concrete and road metal and railroad ballast sold or used by producers in the United States, 1942–46

Year	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1942	107,701,010	$105,583,801	17,566,640	$10,810,977	125,267,650	$116,394,778
1943	82,412,380	83,397,757	17,235,700	11,346,272	99,648,080	94,744,029
1944	64,795,490	66,144,499	18,285,060	12,556,676	83,080,550	78,701,175
1945	64,108,190	65,535,403	21,265,070	14,894,216	85,373,260	80,429,619
1946	90,358,900	97,765,446	16,908,350	13,127,058	107,267,250	110,892,504

Concrete and road metal and railroad ballast sold or used by producers in the United States in 1946, by States

State	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(1)	(1)	(1)	(1)	78,760	$79,917
Alaska	(1)	(1)			(1)	(1)
Arizona	[2] 95,900	[2] $175,608	(1)	(1)	174,050	247,003
Arkansas	367,900	419,024	258,280	$197,296	626,180	616,320
California	6,875,060	5,185,955	483,410	432,442	7,358,470	5,618,397
Colorado	139,710	293,004			139,710	293,004
Connecticut	[2] 1,074,700	[2] 1,342,966	154,610	153,780	[2] 1,229,310	[2] 1,496,746
Delaware	23,070	57,662			23,070	57,662
Florida	[2] 2,446,150	[2] 2,565,068	16,800	16,605	[2] 2,462,950	[2] 2,581,673
Georgia	1,714,590	2,149,514	70,660	65,921	1,785,250	2,215,435
Hawaii	(1)	(1)			(1)	(1)
Idaho	545,120	559,464			545,120	559,464
Illinois	8,047,030	7,752,749	868,230	735,609	8,915,260	8,488,358
Indiana	3,093,080	3,113,564	324,480	315,009	3,417,560	3,428,573
Iowa	2,689,680	3,089,131	(1)	(1)	[2] 2,689,680	[2] 3,089,131
Kansas	1,851,690	2,092,611	[2] 879,920	[2] 238,257	[2] 2,731,610	[2] 2,330,868
Kentucky	[2] 3,514,310	[2] 3,975,668	440,860	299,010	[2] 3,955,170	[2] 4,274,678
Louisiana	(1)	(1)			(1)	(1)
Maine	29,900	39,895	(1)	(1)	[2] 29,900	[2] 39,895
Maryland	1,253,670	1,609,003	223,260	275,411	1,476,930	1,884,414
Massachusetts	[2] 1,406,850	[2] 1,857,496	214,170	210,669	[2] 1,621,020	[2] 2,068,165
Michigan	2,007,050	1,332,467	(1)	(1)	[2] 2,007,050	[2] 1,332,467
Minnesota	[2] 786,580	[2] 864,213	[2] 48,600	[2] 53,400	980,260	1,043,981
Missouri	3,472,660	4,107,171	1,086,630	542,624	4,559,290	4,649,795
Montana	(1)	(1)	(1)	(1)	286,140	277,214
Nebraska	(1)	(1)	(1)	(1)	41,570	73,057
Nevada	[2] 87,810	[2] 122,940			[2] 87,810	[2] 122,940
New Hampshire	63,550	90,590			63,550	90,590
New Jersey	2,720,840	3,534,175	(1)	(1)	[2] 2,720,840	[2] 3,534,175
New Mexico			(1)	(1)	(1)	(1)
New York	6,418,670	7,260,908	[2] 880,190	[2] 727,479	[2] 7,298,860	[2] 7,988,387
North Carolina	3,365,730	4,776,097	739,550	854,061	4,105,280	5,630,158
Ohio	7,254,060	6,885,972	833,170	721,998	8,087,230	7,607,970
Oklahoma	[2] 1,310,430	[2] 1,174,257	[2] 1,555,610	[2] 336,944	2,970,490	1,594,754
Oregon	[2] 1,126,900	[2] 1,552,303	[2] 30,000	[2] 15,000	1,301,270	1,708,251
Pennsylvania	7,428,280	8,552,560	[2] 492,290	[2] 580,177	[2] 7,920,570	[2] 9,132,737
Puerto Rico	[2] 115,640	[2] 238,971	[2] 2,020	[2] 1,736	140,540	269,965
Rhode Island	[2] 2,330	[2] 4,340			[2] 2,330	[2] 4,340
South Carolina	[2] 1,349,040	[2] 1,766,642	473,640	475,341	[2] 1,822,680	[2] 2,241,983
South Dakota	142,470	211,653	[2] 500	[2] 750	[2] 142,970	[2] 212,403
Tennessee	2,958,560	3,513,456	612,920	517,663	3,571,480	4,031,119
Texas	1,854,150	1,582,555	[2] 662,870	[2] 448,808	[2] 2,517,020	[2] 2,031,363
Utah	(1)	(1)	(1)	(1)	271,070	252,358
Vermont	11,280	28,549			11,280	28,549
Virginia	[2] 4,705,620	[2] 5,208,077	739,270	689,086	[2] 5,444,890	[2] 5,897,163
Washington	1,528,750	1,513,543	[2] 1,210,050	[2] 1,071,417	[2] 2,738,800	[2] 2,584,960
West Virginia	[2] 1,077,630	[2] 1,271,782	436,990	369,136	[2] 1,514,620	[2] 1,640,918
Wisconsin	3,370,360	3,355,566	456,100	288,980	3,826,460	3,644,546
Wyoming	62,840	20,693	[2] 559,990	[2] 599,521	[2] 622,830	[2] 620,214
Undistributed	1,969,260	2,517,584	2,153,280	1,892,928	2,950,070	3,276,444
	90,358,900	97,765,446	16,908,350	13,127,058	107,267,250	110,892,504

[1] Included under "Undistributed."
[2] To avoid disclosing confidential information, certain totals are somewhat incomplete, the figures not included being combined under "Undistributed."

COMMERCIAL AND NONCOMMERCIAL OPERATIONS

The accompanying table shows the production of crushed stone for concrete and road metal during recent years by Government agencies of various kinds, contrasted with that by commercial enterprises. For several years prior to 1940, Government-sponsored enterprises produced 29 to 46 percent of the total output. They consisted principally of make-work organizations designed to meet unemployment

and, to a lesser extent, of State, county, and city highway boards or commissions. War conditions changed this situation. Unemployment ceased to be a problem, highway construction (except for military roads) was virtually suspended, and even highway maintenance was widely neglected. Consequently the output of stone by noncommercial agencies had dropped to 7 percent of the total by 1945. Although the noncommercial tonnage increased substantially in 1946, the output of commercial firms increased proportionately and the percentage remained at 7.

Concrete and road metal sold or used by commercial and noncommercial operators in the United States, 1942–46

[Figures for "noncommercial operations" represent tonnages reported by States, counties, municipalities, and other Government agencies, produced either by themselves or by contractors expressly for their consumption, often with publicly owned equipment; they do not include purchases from commercial producers. Figures for "commercial operations" represent tonnages reported by all other producers]

Year	Commercial operations				Noncommercial operations				Total	
	Short tons	Average value per ton	Percent of change in quantity from preceding year	Percent of total quantity	Short tons	Average value per ton	Percent of change in quantity from preceding year	Percent of total quantity	Short tons	Percent of change in quantity from preceding year
1942	92,251,930	$0.97	+22	86	15,449,080	$1.05	−55	14	107,701,010	−2
1943	74,906,610	1.01	−19	91	7,505,770	1.05	−51	9	82,412,380	−23
1944	56,815,950	1.02	−24	88	7,979,540	1.06	+6	12	64,795,490	−21
1945	59,347,220	1.01	+4	93	4,760,970	1.12	−40	7	64,108,190	−1
1946	83,879,680	1.07	+41	93	6,479,220	1.23	+36	7	90,358,900	+41

GRANULES

Beginning with 1942, the coverage of granules for roofing purposes has been more complete than in former years. The following table shows total production for the past 5 years. Separate figures for slate granules are given in the chapter on Slate.

Roofing granules [1] sold or used in the United States, 1942–46, by kinds

Year	Natural		Artificially colored		Brick		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1942	352,320	$2,650,503	538,310	$7,594,174	43,230	$636,961	933,860	$10,881,638
1943	287,090	2,190,143	543,870	7,745,452	47,650	716,685	878,610	10,652,280
1944	287,080	2,210,379	637,090	9,313,356	65,830	1,005,964	990,000	12,529,699
1945	355,840	2,628,052	628,220	9,124,891	61,220	947,637	1,045,280	12,700,580
1946	447,910	3,470,411	877,990	12,939,512	54,660	866,174	1,380,560	17,276,097

[1] Manufactured from stone, slate, slag, and brick.

SIZE OF PLANTS

In 1945 the average crushed-stone plant produced about 99,000 tons. Almost half (47 percent) of the plants reported less than 25,000 tons, but they contributed only 4 percent of the total output. On the other hand, the 19 plants that produced 900,000 tons or more contributed almost 25 percent of the total. The accompanying table shows additional details of the size pattern of the industry. Comparable statistics have been published in Minerals Yearbook for each year beginning with 1941.

Number and production of commercial crushed-stone [1] plants in 1945, by sizes of output

Range of output	Number of plants	Total production of plants (short tons)	Percent of total	Cumulative total (short tons)
Less than 1,000 tons	80	36,290	0.02	36,290
1,000 to 25,000	607	6,234,740	4.29	6,271,030
25,000 to 50,000	242	8,537,230	5.88	14,808,260
50,000 to 75,000	135	8,262,000	5.69	23,070,260
75,000 to 100,000	73	6,329,930	4.36	29,400,190
100,000 to 200,000	165	23,279,060	16.03	52,679,250
200,000 to 300,000	67	16,664,430	11.47	69,343,680
300,000 to 400,000	29	9,837,540	6.77	79,181,220
400,000 to 500,000	22	9,839,090	6.77	89,020,310
500,000 to 600,000	11	5,923,690	4.08	94,944,000
600,000 to 700,000	10	6,354,620	4.38	101,298,620
700,000 to 800,000	5	3,710,640	2.56	105,009,260
800,000 to 900,000	5	4,163,060	2.87	109,172,320
900,000 tons and over	19	36,062,720	24.83	145,235,040
Total	1,470	145,235,040	100.00	145,235,040

[1] Exclusive of marble, which is primarily a dimension-stone industry.

METHODS OF TRANSPORTATION

As shown in the accompanying table, truck transportation is the principal method used in the crushed-stone industry, and rail is a close second. Waterways provide minor but locally important facilities. In previous years the table has included only the transportation statistics of the commercial stone used for concrete and road metal. Beginning with 1946, the table will include all commercial crushed stone.

Crushed stone sold or used in the United States in 1946, by methods of transportation

Method of transportation	Commercial operations		Commercial and noncommercial [1] operations	
	Short tons	Percent of total	Short tons	Percent of total
Truck	73,076,890	43	80,918,070	46
Rail	55,627,720	33	55,627,720	31
Waterway	14,765,600	9	14,765,600	8
Unspecified	26,166,390	15	26,166,390	15
	169,636,600	100	177,477,780	100

[1] For practical purposes it is assumed that the entire output of noncommercial operations is moved by truck.

GRANITE

Sales of crushed and broken granite increased 43 percent in quantity and 58 percent in value in 1946. The average sales value per ton increased 12 cents. Sales of riprap declined in quantity but increased in value. Crushed granite for concrete and road metal gained 51 percent in quantity and 84 percent in total value, and the average value per ton was 22 cents higher than in 1945. Granite sold as railroad ballast advanced 13 percent in quantity and 24 percent in value. The average sales value of ballast increased 9 cents a ton. As shown in the accompanying table, granite is produced in a great many States, but the bulk of the output comes from the Southeastern States. North Carolina was the principal producer in 1946, followed by Georgia, South Carolina, California, and Virginia, in that order.

The number of individual operations supplying noncommercial crushed stone cannot be determined with any degree of accuracy from the reports submitted. Therefore, in the accompanying tables covering granite and most other kinds of crushed and broken stone, the number of active plants is not given. For many years before 1939, when noncommercial production was less important, such figures appeared in the tables.

BASALT AND RELATED ROCKS (TRAP ROCK)

Basalt, gabbro, diorite, and other dark igneous rocks that are known commercially as trap rock are widely used in the construction industry. In 1946 New Jersey was the leading State, but Washington produced nearly as much. They were followed by California, Massachusetts, Pennsylvania, Connecticut, and Oregon. Total sales of crushed and broken trap rock were 11 percent greater in quantity and 19 percent greater in value in 1946 than in 1945. The average value per ton increased from $1.18 to $1.26. See second table following.

Granite (crushed and broken stone) sold or used by producers in the United States in 1946, by States and uses

State	Riprap		Crushed stone				Other uses [1]		Total	
			Concrete and road metal		Railroad ballast					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Arizona	(2)	(2)							(2)	(2)
California	142,920	$233,698	707,830	$567,035	(2)	(2)	(2)	(2)	1,567,540	$1,214,966
Colorado			(2)	(2)					(2)	(2)
Connecticut	(2)	(2)					110	$680	(2)	(2)
Delaware			23,070	57,662					23,070	57,662
Georgia	3,240	6,669	1,549,290	1,929,476	70,660	$65,921	163,050	544,256	1,786,240	2,546,322
Idaho	(2)	(2)	(2)	(2)					(2)	(2)
Maine	840	1,881	9,460	23,655			2,840	3,978	13,140	29,514
Maryland	(2)	(2)	(2)	(2)	(2)	(2)			91,370	163,770
Massachusetts	(2)	(2)	250,440	310,426			(2)	(2)	331,420	411,168
Minnesota	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	161,840	170,989
Missouri	(2)	(2)							(2)	(2)
Montana	(2)	(2)	(2)	(2)					(2)	(2)
New Hampshire	100	200	46,550	69,340			530	797	47,180	70,337
New Jersey			(2)	(2)					(2)	(2)
New York	(2)	(2)	(2)	(2)					(2)	(2)
North Carolina	(2)	(2)	1,822,260	2,620,915	(2)	(2)	217,830	261,077	2,911,870	3,925,165
Oklahoma	(2)	(2)	(2)	(2)					(2)	(2)
Pennsylvania	4,700	7,000	51,000	71,400					55,700	78,400
Puerto Rico			(2)	(2)					(2)	(2)
Rhode Island	1,480	1,876	2,330	4,340			670	1,128	4,480	7,344
South Carolina	(2)	(2)	1,161,310	1,526,600	473,640	475,341	(2)	(2)	1,693,290	2,031,943
South Dakota			(2)	(2)					(2)	(2)
Vermont			(2)	(2)					(2)	(2)
Virginia	(2)	(2)	819,790	942,413	294,220	296,362	(2)	(2)	1,157,610	1,292,177
Washington	(2)	(2)			(2)	(2)	(2)	(2)	17,170	59,614
Wisconsin	(2)	(2)	(2)	(2)	(2)	(2)			136,840	110,703
Wyoming			(2)	(2)	390,910	445,642			(2)	(2)
Undistributed	337,360	462,420	360,520	341,811	1,124,620	1,119,983	550,690	385,826	585,500	609,734
	490,640	713,744	6,803,850	8,465,073	2,354,050	2,403,249	935,720	1,197,742	10,584,260	12,779,808
Average unit value		$1.45		$1.24		$1.02		$1.28		$1.21

[1] Includes stone used for concrete pipe, poultry grit, stone sand, and unspecified uses. [2] Included under "Undistributed."

Basalt and related rocks (trap rock) (crushed and broken stone) sold or used by producers in the United States in 1946, by States and uses

State	Riprap		Crushed stone				Other uses [1]		Total	
			Concrete and road metal		Railroad ballast					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Arizona			66,900	$148,383					66,900	$148,383
California	(2)	(2)	1,638,870	1,481,761	(2)	(2)			1,784,690	1,656,179
Colorado	(2)	(2)	(2)	(2)					(2)	(2)
Connecticut	12,560	$12,388	1,074,700	1,342,966	154,610	$153,780			1,241,870	1,509,134
Hawaii	(2)	(2)	(2)	(2)					728,070	1,168,286
Idaho	(2)	(2)	(2)	(2)					280,840	374,715
Maine			(2)	(2)					(2)	(2)
Maryland			(2)	(2)	(2)	(2)			482,740	658,231
Massachusetts	20,710	20,233	1,156,310	1,546,858	214,170	210,669	30,170	$81,547	1,421,360	1,859,307
Michigan			(2)	(2)					(2)	(2)
Minnesota	(2)	(2)	16,000	18,400	48,600	53,400	(2)	(2)	77,920	75,130
Montana	(2)	(2)							(2)	(2)
New Jersey	372,190	648,349	2,491,820	3,270,868	(2)	(2)	(2)	(2)	2,956,100	4,029,042
New York	1,360	816	895,510	1,205,790	51,670	60,638			948,540	1,267,244
Oregon	56,810	51,393	1,126,900	1,552,303	30,000	15,000			1,213,710	1,618,696
Pennsylvania	(2)	(2)	1,003,890	1,158,118	(2)	(2)			1,383,770	1,582,999
Puerto Rico			670	520	2,020	1,736			2,690	2,256
Texas			(2)	(2)	(2)	(2)			(2)	(2)
Virginia			340,030	446,533					340,030	446,533
Washington	204,380	206,586	1,509,890	1,494,577	1,210,050	1,071,417			2,924,320	2,772,580
Wisconsin	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Undistributed	125,190	172,496	1,541,600	2,434,245	818,990	862,459	133,620	888,504	496,640	1,444,018
	793,200	1,112,261	12,863,090	16,101,322	2,530,110	2,429,099	163,790	970,051	16,350,190	20,612,733
Average unit value		$1.40		$1.25		$0.96		$5.92		$1.26

[1] Includes stone sold for rock-wool manufacture, roofing granules, waste, and unspecified uses.
[2] Included under "Undistributed."

MARBLE

Marble producers accumulate large quantities of waste material consisting either of defective blocks or cuttings and spalls from marble-dressing operations. This byproduct material is marketed for the variety of uses listed in the footnote of the accompanying table. The average value varies considerably from State to State because in some States a large portion is marketed for high-priced products, such as terrazzo or marble flour, whereas in others much must be sold for road stone, concrete aggregates, or other low-priced uses.

Marble (crushed and broken stone) sold by producers in the United States in 1946, by States [1]

State	Active plants	Short tons	Value	State	Active plants	Short tons	Value
Alabama	2	(2)	(2)	Texas	1	11,000	$140,000
California	1	(2)	(2)	Utah	1	1,230	11,668
Colorado	1	5,990	$23,976	Virginia	1	(2)	(2)
Georgia	1	13,300	71,963	Washington	4	350	1,442
Maryland	1	4,770	57,760	Undistributed		75,390	424,492
Missouri	1	2,860	17,160				
New York	1	(2)	(2)	Total	20	128,250	838,964
Pennsylvania	1	(2)	(2)	Average unit value			$6.54
Tennessee	4	13,360	90,503				

[1] Includes stone used for agriculture, asphalt filler, cast stone, composition flooring, crushed stone, flux, mineral food, poultry grit, riprap, shingles, spalls, terrazzo, tile, whiting (excluding marble whiting made by companies that purchase their marble), and unspecified uses.
[2] Included under "Undistributed."

LIMESTONE

Because of its wide distribution, moderate production cost, and essentiality in the manufacturing as well as the construction industries, limestone is used more extensively than any other type of crushed and broken stone. In 1946, limestone (excluding that used for making cement and lime) constituted 76 percent of the total crushed and broken stone produced in the United States. Output was reported from 44 States and 3 Territories and was 20 percent greater than in 1945. Owing to the upward trend in construction, sales for use as concrete aggregates and road metal increased 47 percent. As farm income was exceptionally high, the tonnage of agricultural limestone rose 31 percent. On the other hand, output of fluxing stone and ballast declined. The tonnages consumed in "Miscellaneous Uses," which as a group gained 10 percent, are shown in an accompanying table.

Limestone (crushed and broken stone) sold or used by producers in the United States in 1946, by States and uses

State	Riprap		Fluxing stone		Crushed stone				Agriculture		Miscellaneous		Total	
					Concrete and road metal		Railroad ballast							
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			1,363,580	$1,215,921	(1)	(1)	(1)	(1)	185,260	$201,737	158,350	$973,672	1,785,950	$2,471,247
Alaska					(1)	(1)							(1)	(1)
Arizona			15,540	17,256	(1)	(1)	(1)	(1)					93,690	88,651
Arkansas	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	65,920	112,447	(1)	(1)	166,300	283,962
California	(1)	(1)	115,440	238,986	522,480	$389,146	(1)	(1)	(1)	(1)	377,910	1,173,440	1,037,190	1,827,541
Colorado			282,760	222,727	(1)	(1)					161,020	201,562	464,810	444,089
Connecticut	320	$405	(1)	(1)	(1)	(1)			57,000	191,527	(1)	(1)	74,710	241,231
Florida	100	155			2,446,150	2,565,068	16,800	$16,605	107,130	372,401	292,890	257,906	2,863,070	3,212,135
Georgia			1,400	2,945	160,720	207,688			189,430	328,332	111,910	310,718	463,460	849,683
Hawaii											4,350	6,774	4,350	6,774
Idaho					243,030	171,019					2,750	7,695	245,780	178,714
Illinois	155,090	188,766	816,090	964,272	8,028,640	7,735,049	868,230	735,609	5,226,260	6,142,991	507,870	1,079,188	15,602,180	16,845,875
Indiana	20,600	21,173	80,240	53,618	3,056,080	3,080,564	324,480	315,009	1,863,900	2,104,637	114,470	325,148	5,459,770	5,900,149
Iowa	144,950	163,905	16,620	21,942	2,689,680	3,089,131	(1)	(1)	2,237,300	3,071,496	(1)	(1)	5,161,260	6,643,033
Kansas	133,170	189,313	(1)	(1)	1,449,890	1,866,115	(1)	(1)	612,180	932,992	(1)	(1)	2,308,350	3,211,827
Kentucky	(1)	(1)			3,507,090	3,967,492	440,860	299,010	745,980	864,412	(1)	(1)	4,738,070	5,197,266
Louisiana					(1)	(1)					(1)	(1)	(1)	(1)
Maine	(1)	(1)			(1)	(1)			(1)	(1)	(1)	(1)	120,020	295,193
Maryland	(1)	(1)	(1)	(1)	901,090	1,088,117	(1)	(1)	43,570	120,423	(1)	(1)	1,074,600	1,505,058
Massachusetts			18,370	32,873	100	212			126,170	435,716	47,270	248,214	191,910	717,015
Michigan	(1)	(1)	7,947,960	4,258,561	1,977,770	1,290,209	(1)	(1)	585,560	613,606	4,718,400	3,487,056	15,382,150	9,788,713
Minnesota	(1)	(1)	(1)	(1)	770,580	845,813			191,670	290,405	(1)	(1)	998,140	1,229,187
Mississippi									(1)	(1)			(1)	(1)
Missouri	212,100	319,219	15,180	20,037	3,022,450	3,960,953	125,600	136,071	1,445,460	2,223,431	511,450	1,013,240	5,332,240	7,672,951
Montana	(1)	(1)	(1)	(1)	(1)	(1)					26,710	47,529	95,690	120,778
Nebraska	63,890	88,564			(1)	(1)	(1)	(1)			158,470	450,499	263,930	612,120
Nevada			(1)	(1)	(1)	(1)					(1)	(1)	(1)	(1)
New Jersey			(1)	(1)	43,990	66,170			(1)	(1)	(1)	(1)	275,500	993,580
New Mexico							(1)	(1)					(1)	(1)
New York	197,370	330,581	61,030	54,987	5,412,800	5,962,277	828,520	666,841	514,990	1,551,030	1,741,970	1,583,568	8,756,680	10,149,284
North Carolina					1,141,730	1,473,721	(1)	(1)	(1)	(1)			1,162,180	1,497,031
Ohio	16,070	12,361	4,874,750	3,759,672	7,218,800	6,865,220	833,170	721,998	2,723,440	3,424,178	1,011,050	1,577,515	16,677,280	16,360,944
Oklahoma	(1)	(1)	(1)	(1)	983,450	980,569	(1)	(1)	335,460	533,244	(1)	(1)	1,511,810	1,692,320
Oregon							(1)	(1)	60,330	191,405	(1)	(1)	118,520	252,232
Pennsylvania	113,780	145,071	6,826,380	7,210,169	5,901,340	6,750,313	345,280	397,314	1,188,770	3,121,404	1,653,230	3,002,500	16,028,780	20,626,771
Puerto Rico					114,970	238,451	(1)	(1)	(1)	(1)	(1)	(1)	124,530	250,459
South Carolina			(1)	(1)	187,730	240,042			54,660	81,925			(1)	(1)
South Dakota	3,230	5,698			84,800	122,734	500	750			2,800	5,625	91,330	134,807

Tennessee	93,350	144,654	27,320	32,360	2,958,560	3,513,456	612,920	517,663	1,282,190	1,388,588	138,410	304,001	5,112,750	5,900,722
Texas	(1)	(1)	36,490	40,770	1,319,790	1,322,234	662,870	448,808	(1)	(1)	303,940	406,298	2,446,170	2,296,814
Utah			(1)	(1)	(1)	(1)					60,010	226,893	139,860	307,085
Vermont			(1)	(1)	(1)	(1)			(1)	(1)	(1)	(1)	119,410	829,098
Virginia	29,110	31,285	351,430	386,866	3,434,800	3,687,407	433,130	383,787	857,680	1,024,549	898,170	1,197,050	6,004,320	6,710,944
Washington			940	1,298	(1)	(1)			(1)	(1)	117,090	270,818	132,400	315,503
West Virginia			2,000,180	1,872,287	1,077,630	1,271,782	436,990	369,136	117,040	223,502	375,820	529,300	4,007,660	4,266,007
Wisconsin	13,620	12,014	32,420	29,863	3,151,020	3,118,587	416,100	264,546	1,531,710	2,094,448	48,100	68,208	5,192,970	5,587,666
Wyoming	(1)	(1)	(1)	(1)	(1)	(1)	169,080	153,879			(1)	(1)	517,300	571,867
Undistributed	393,370	397,554	273,640	354,423	463,410	437,466	815,890	656,176	432,690	842,081	1,538,310	3,300,211	1,886,270	1,683,967
	1,590,120	2,050,718	25,157,760	20,791,833	62,270,570	66,307,005	7,330,420	6,083,202	22,781,750	32,482,907	15,082,720	22,054,628	134,213,340	149,770,293
Average unit value		$1.29		$0.83		$1.06		$0.83		$1.43		$1.46		$1.12

[1] Included under "Undistributed."

Limestone (crushed and broken stone) sold or used by producers in the United States for miscellaneous uses, 1945–46

Use	1945		1946	
	Short tons	Value	Short tons	Value
Alkali works	7,076,330	$4,068,060	7,418,690	$5,230,804
Calcium carbide works	549,510	639,833	411,660	437,231
Coal-mine dusting	216,160	680,723	208,830	632,729
Filler (not whiting substitute):				
Asphalt	455,360	971,570	459,020	1,270,734
Fertilizer	401,160	661,348	553,680	1,076,728
Other	138,750	428,991	220,370	645,440
Filter beds	20,920	38,322	16,410	33,324
Glass factories	[1] 556,610	[1] 937,615	648,250	1,163,161
Limestone sand	615,400	482,093	622,230	437,882
Limestone whiting [2]	343,220	2,905,637	405,380	3,523,025
Magnesia works (dolomite) [3]	295,540	373,919	294,360	464,750
Mineral food	291,580	1,310,757	373,630	1,697,507
Mineral (rock) wool	39,170	39,575	22,200	23,400
Paper mills	352,990	620,943	385,620	685,912
Poultry grit	114,670	751,469	117,630	822,985
Refractory (dolomite)	1,027,090	1,120,136	1,035,110	1,146,864
Road base	298,930	233,979	283,820	252,806
Stucco, terrazzo, and artificial stone	25,590	148,332	25,830	171,113
Sugar factories	[1] 340,310	[1] 691,922	378,720	693,058
Other uses [4]	199,800	300,319	447,350	543,291
Use unspecified	305,250	423,321	753,930	1,101,884
	13,664,340	17,828,864	15,082,720	22,054,628

[1] Revised figure.
[2] Includes stone for filler for calcimine, caulking compounds, explosives, foundry compounds, glue, insecticides, leather goods, linoleum, paint, paper, phonograph records, plastics, pottery, putty, roofing, rubber, tooth paste, wire coating, and unspecified uses.
[3] Includes stone for refractory magnesia.
[4] Includes stone for acid neutralization, athletic-field marking, carbon dioxide, chemicals (unspecified), concrete blocks and pipes, dyes, electric products, fill material, magnesium metal, motion-picture snow, oil-well drilling, rayon, spalls, waste rock, and water treatment.

Dolomite (calcium-magnesium carbonate) has a variety of uses, some of which are quite distinct from those of high-calcium limestone. Dead-burned dolomite is used as a refractory lining for metallurgical furnaces, and statistical data on this product (which is closely allied to lime) are given in the Lime chapter of this volume. Raw dolomite is also used as a refractory, particularly for patching furnace floors. Dolomite is also used as a source of magnesia (MgO), which may be applied to refractory use, employed for heat insulation, or used in various other ways. In 1943, for the first time, dolomite was used extensively as a source of magnesium metal. This use declined owing to the cut-back in the metal program, and none was reported for 1946.

Sales of dolomite and its primary product of calcination—dolomitic lime—for certain uses are covered in the accompanying table.

Dolomite and dolomitic lime sold or used by producers in the United States for specified purposes, 1945–46

	1945		1946	
	Short tons	Value	Short tons	Value
Dolomite for—				
Basic magnesium carbonate [1]	295,540	$373,919	294,360	$464,750
Magnesium metal	(2)	(2)		
Refractory uses	1,027,090	1,120,136	1,035,110	1,146,864
Dolomitic lime for—				
Refractory (dead-burned dolomite)	1,187,330	10,613,711	1,077,980	10,101,707
Paper mills	52,000	413,000	35,000	323,000
Total (calculated as raw stone)	3,801,000		3,555,000	

[1] Includes dolomite for refractory magnesia.
[2] Bureau of Mines not at liberty to publish figures.

The following table shows the tonnages and values of fluxing stone sold for use in various metallurgical operations.

Sales of fluxing limestone, 1942–46, by uses

Year	Blast furnaces		Open-hearth plants		Other smelters [1]		Other metallurgical [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1942	23,663,630	$18,523,158	5,843,820	$4,886,157	494,720	$460,270	257,080	$277,728	30,259,250	$24,147,313
1943	24,755,920	18,785,578	5,932,900	4,899,369	671,990	581,325	209,840	239,295	31,570,650	24,505,567
1944	24,045,890	18,954,798	6,158,870	5,251,987	557,830	547,277	317,740	376,051	31,080,330	25,130,113
1945	21,901,820	17,111,472	5,038,140	4,286,889	502,230	491,178	197,330	186,854	27,639,520	22,076,393
1946	19,674,130	15,803,857	4,869,300	4,342,467	449,050	490,566	165,280	154,943	25,157,760	20,791,833

[1] Includes flux for copper, gold, lead, zinc, and unspecified smelters.
[2] Includes flux for foundries and for cupola and electric furnaces.

As the statistics of the lime and cement industries are presented in separate chapters of Minerals Yearbook, they are not covered in the Stone chapter. However, a commodity review of limestone would be incomplete without recognition of the large tonnage of limestone consumed by these industries. Consequently, the following table shows the total tonnage of limestone consumed for all purposes.

Limestone sold or used for all purposes in the United States, 1944–46, in short tons

Use	1944	1945	1946
Limestone (as given in this report) (approximate)	115,506,000	[1] 112,574,000	134,717,000
Portland and natural cement and cement rock [2]	24,148,000	27,332,000	43,877,000
Lime [3]	12,947,000	11,841,000	11,985,000
	152,601,000	[1] 151,747,000	190,579,000

[1] Revised figure.
[2] Reported in terms of cement in chapter on Cement.
[3] Reported in terms of lime in chapter on Lime.

SANDSTONE

The output of crushed sandstone in 1946 was 5 percent lower than in 1945, but its value was 14 percent greater. The principal decline was in the tonnage of refractory stone; smaller decreases were reported for ballast and concrete and road metal. The output for riprap and "other uses" increased. Average unit values for all uses increased. See details in accompanying table.

MISCELLANEOUS STONE

Crushed and broken stone, other than the five principal varieties already discussed, includes light-color volcanic rocks, schists, boulders from river beds, serpentine, and flint. The following table shows sales of stone of these types in 1946. Total sales decreased 11 percent in tonnage and 4 percent in value compared with 1945. See second table following.

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Sandstone (crushed and broken stone) sold or used by producers in the United States in 1946, by States and uses

State	Refractory stone (ganister)		Riprap		Crushed stone				Other uses [1]		Total	
					Concrete and road metal		Railroad ballast					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(2)	(2)									(2)	(2)
Arkansas					(2)	(2)					(2)	(2)
California	3,680	$36,770	(2)	(2)	721,940	$466,832	(2)	(2)	(2)	(2)	1,037,190	$855,162
Colorado	18,540	30,255	500	$500							19,040	30,755
Georgia					(2)	(2)					(2)	(2)
Illinois	310	3,250			(2)	(2)					(2)	(2)
Indiana					(2)	(2)					(2)	(2)
Kansas			7,030	7,575	35,550	44,380			100	$150	42,680	52,105
Kentucky					7,220	8,176					7,220	8,176
Massachusetts					(2)	(2)					(2)	(2)
Minnesota			(2)	(2)							(2)	(2)
Missouri			(2)	(2)							(2)	(2)
Montana			(2)	(2)			(2)	(2)			(2)	(2)
New York	(2)	(2)	(2)	(2)	(2)	(2)					96,120	124,870
North Carolina					(2)	(2)					(2)	(2)
Ohio	63,550	496,933	(2)	(2)					(2)	(2)	205,260	1,257,787
Oklahoma					(2)	(2)					(2)	(2)
Pennsylvania	568,120	1,521,688	(2)	(2)	388,610	442,058	147,010	$182,863	(2)	(2)	1,113,850	2,159,246
South Dakota	80,070	145,723	127,530	181,464	(2)	(2)	(2)	(2)	(2)	(2)	259,400	414,186
Tennessee	(2)	(2)									(2)	(2)
Texas					4,200	6,800					4,200	6,800
Utah	(2)	(2)									(2)	(2)
Virginia	63,240	140,237			111,000	131,724	11,920	8,937	10,650	8,349	196,810	289,247
West Virginia	(2)	(2)	(2)	(2)	(2)	(2)					123,880	198,041
Wisconsin	140,580	328,400	50,000	54,000	(2)	(2)			(2)	(2)	563,940	2,994,402
Wyoming			(2)	(2)							(2)	(2)
Undistributed	96,180	243,990	372,660	410,338	447,880	730,566	110,860	123,275	504,030	3,324,991	423,370	689,447
	1,034,270	2,947,246	557,720	653,877	1,716,400	1,830,536	269,790	315,075	514,780	3,333,490	4,092,960	9,080,224
Average unit value		$2.85		$1.17		$1.07		$1.17		$6.48		$2.22

[1] Includes sandstone for chemical use, concrete blocks, filter stone, poultry grit, rock wool, roofing granules, spalls, stone sand, and unspecified uses.
[2] Included under "Undistributed."

Miscellaneous varieties of stone (crushed and broken stone) sold or used by producers in the United States in 1946, by States and uses

State	Riprap		Crushed stone				Other uses [1]		Total	
			Concrete and road metal		Railroad ballast					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alaska	(2)	(2)							(2)	(2)
Arizona			29,000	$27,225					29,000	$27,225
Arkansas	(2)	(2)	(2)	(2)	(2)	(2)			(2)	(2)
California	79,360	$77,047	3,283,940	2,281,181	(2)	(2)	(2)	(2)	3,504,790	2,528,313
Colorado			(2)	(2)					(2)	(2)
Florida			(2)	(2)					(2)	(2)
Georgia			(2)	(2)					(2)	(2)
Idaho			(2)	(2)					(2)	(2)
Illinois			(2)	(2)					(2)	(2)
Indiana			(2)	(2)					(2)	(2)
Kansas [3]	30,440	27,181	[4] 366,250	[4] 182,116	879,920	$238,257			[4] 1,276,610	[4] 447,554
Kentucky			(2)	(2)					(2)	(2)
Maine			(2)	(2)	(2)	(2)			(2)	(2)
Maryland	1,920	5,272	(2)	(2)			(2)	(2)	(2)	(2)
Massachusetts	(2)	(2)	(2)	(2)					(2)	(2)
Michigan			(2)	(2)			(2)	(2)	28,010	146,645
Missouri [5]			[4] 450,210	[4] 146,218	961,030	406,553	477,790	$209,377	[4] 1,889,030	[4] 762,148
Montana					(2)	(2)			(2)	(2)
Nevada			87,810	122,940					87,810	122,940
New Hampshire			17,000	21,250			830	1,035	17,830	22,285
New Jersey			(2)	(2)					(2)	(2)
New York			(2)	(2)	(2)	(2)			(2)	(2)
North Carolina			(2)	(2)					(2)	(2)
Ohio			35,260	20,752					35,260	20,752
Oklahoma [3]			326,980	193,688	1,555,610	336,944			1,882,590	530,632
Oregon			(2)	(2)	(2)	(2)			140,470	137,446
Pennsylvania	(2)	(2)	83,440	130,671			(2)	(2)	158,970	673,429
Puerto Rico			(2)	(2)					(2)	(2)
Rhode Island			(2)	(2)					(2)	(2)
South Carolina			(2)	(2)					(2)	(2)
South Dakota			(2)	(2)					(2)	(2)
Texas	(2)	(2)	(2)	(2)	(2)	(2)			(2)	(2)
Utah	(2)	(2)	(2)	(2)	(2)	(2)			(2)	(2)
Virginia			(2)	(2)			(2)	(2)	160,020	186,640
Washington	(2)	(2)	(2)	(2)					62,270	54,311
Wisconsin			(2)	(2)	(2)	(2)			30,660	28,484
Wyoming					(2)	(2)			(2)	(2)
Undistributed	280,150	314,907	2,025,100	1,935,469	1,027,420	914,679	109,320	692,482	2,805,460	2,596,440
	391,870	424,407	6,704,990	5,061,510	4,423,980	1,896,433	587,940	902,894	12,108,780	8,285,244
Average unit value		$1.08		$0.75		$0.43		$1.54		$0.68

[1] Includes stone used for agriculture, mineral filler, refractory, roofing granules, spalls, and unspecified uses.
[2] Included under "Undistributed."
[3] Chats; figures collected by Joplin, Mo., office of the Bureau of Mines.
[4] Includes a small quantity of stone.
[5] Chats and chert aggregates; figures collected by Joplin, Mo., office of the Bureau of Mines.

MARKETS

As has been shown in preceding sections of this chapter, the principal use of crushed stone is as concrete aggregates and road metal used in construction of buildings and highways. The tonnage of stone sold for such uses is compared, in figure 3, with the shipments of portland cement, the area of new concrete pavements, and the value of new construction. There is a definite correlation of trends, but stone output has shown somewhat less variation than the other statistical series. The trend in demand for crushed stone in construction was upward in 1946, and the prospect of further increase was good.

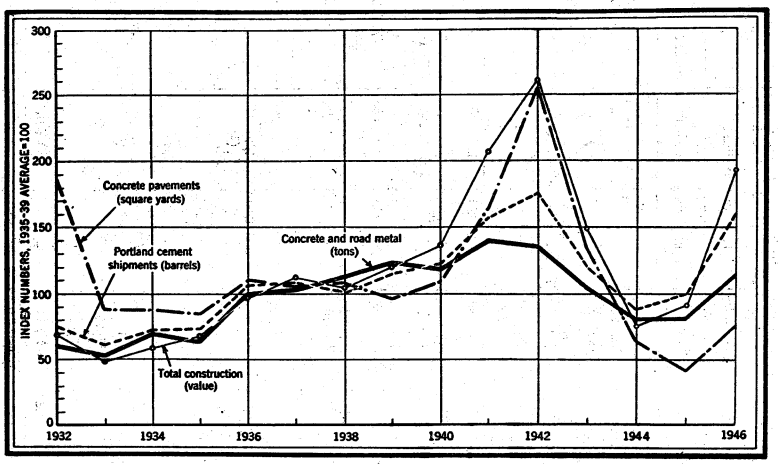

FIGURE 3.—Crushed-stone aggregates (concrete and road metal) sold or used in the United States compared with shipments of portland cement, total construction (value), and concrete pavements (contract awards, thousands of square yards), 1932–46. Data on construction and concrete pavements from Bureau of Foreign and Domestic Commerce.

The metallurgical industries operated at high rates during most of 1946. However, pig-iron production—nearly 45 million tons—was 16 percent lower than in 1945, and steel production, nearly 67 million tons, was 16 percent lower. Consequently, sales of fluxing stone declined 9 percent. Similarly, sales of refractories, such as dead-burned dolomite and ganister used in silica brick, declined. The correlations of fluxing-stone output with pig-iron production, and of refractory stone with steel-ingot production are shown in figure 4.

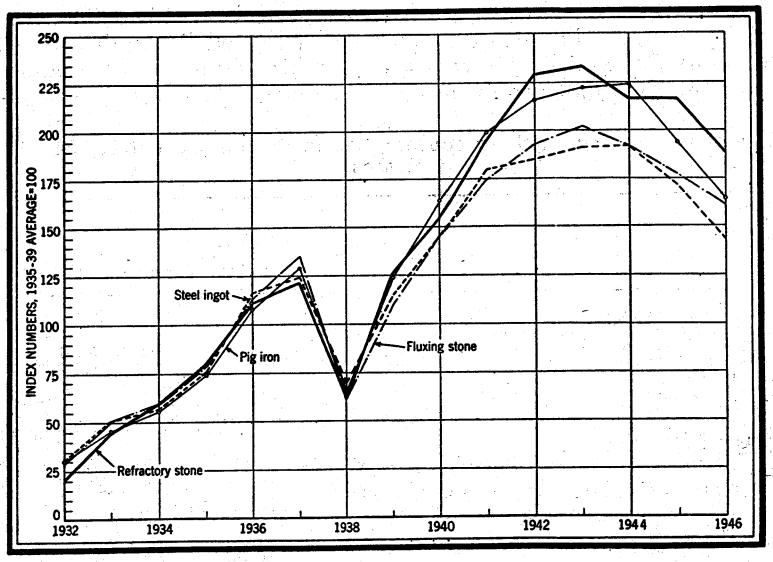

FIGURE 4.—Sales (tons) of fluxing stone and refractory stone, including that used in making lime, as recorded in the chaper on Lime, compared with production of steel ingot and pig iron, 1932–46. Statistics of steel-ingot production compiled by American Iron and Steel Institute.

TECHNOLOGIC DEVELOPMENTS

It was reported in 1946 that the use of "skull crackers" was increasing because of a shortage of drillers for secondary blasting. Many operators report that the drop ball can equal or exceed the efficiency and economy of secondary blasting, but some report relatively poor results. A variety of shapes of ball are used, and the drop may range from 6 to 50 feet. The ball usually weighs between 4,000 and 7,000 pounds.[2]

One of the problems encountered by the managements of crushed-stone plants is the damage sometimes done to neighboring buildings by quarry blasts. Consequently, considerable interest in delayed-action blasting has developed. In this method the blasts in successive holes are separated by small intervals of time, and it is said that the resultant shock wave will not damage property. The reduction in shock has been substantiated by seismic measurements. Another advantage claimed for the method is better breakage of the rock.[3]

FOREIGN TRADE[4]

Importation of stone into the United States increased greatly in 1946—total value was three times as great as in 1945. The greatest gain was made by marble (which comes principally from Italy). The value of marble imports was 11 times greater than in 1945. Granite imports were 7 times greater and other classes increased smaller amounts.

[2] Pit and Quarry, vol. 38, No. 9, March 1946, p. 86.
Cooke, T. C., Reduce Oversize Stone with Drop Ball: Rock Products, vol. 49, No. 9, September 1946, pp. 56–57.
[3] Miller, L. F., Delayed-Action Blasting: Rock Products, vol. 50, No. 3, March 1947, pp. 83–85.
[4] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

The export trade in stone also increased in 1946, but was still relatively small. These products are distributed in small quantities throughout the world. However, the bulk is shipped to Canada and most of the remainder to other countries in the Western Hemisphere.

Stone and whiting imported for consumption in the United States, 1945–46, by classes

Class	1945		1946	
	Quantity	Value	Quantity	Value
Marble, breccia, and onyx:				
Sawed or dressed, over 2 inches thick—cubic feet			1	$4
In blocks, rough, etc—do	8,218	$44,292	105,997	520,479
Slabs or paving tiles—superficial feet			39,792	22,075
All other manufactures		13,854		101,588
		58,146		644,146
Granite:				
Dressed—cubic feet	1,137	4,509	17,379	138,788
Rough—do	29,219	50,239	100,765	261,879
Paving blocks, wholly or partly manufactured—number			8	295
		54,748		400,962
Quartzite—short tons	131,003	346,968	215,084	548,004
Travertine stone—cubic feet	7,623	19,014	84,710	133,334
Stone (other):				
Dressed		383		1,175
Rough (monumental or building stone)—cubic feet	1,249	748	3,183	5,111
Rough (other)—short tons	52,567	52,287	33,727	59,316
Marble chip or granite—do	110	1,010	3,881	44,533
Crushed or ground, n. s. p. f.				4,585
		54,428		114,720
Whiting:				
Chalk or whiting, precipitated—short tons	3,007	120,605	2,190	85,506
Whiting, dry, ground, or bolted—do	882	11,398	5,381	67,437
Whiting, ground in oil (putty)—do	1	88	1	121
		132,091		153,064
Grand total		665,395		1,994,230

Stone exported from the United States, 1942–46

Year	Marble and other building and monumental stone		Other manufactures of stone (value)
	Cubic feet	Value	
1942	70,072	$172,783	$229,993
1943	65,614	184,772	151,650
1944	78,164	201,036	176,423
1945	119,004	337,666	174,874
1946	224,692	463,572	280,380

Sulfur and Pyrites

By G. W. JOSEPHSON AND M. G. DOWNEY[1]

	PAGE		PAGE
General summary	1135	Sulfur—continued	
Salient statistics	1136	Foreign trade	1141
Sulfur	1137	World production	1143
Domestic production	1137	Pyrites	1145
Review by States	1137	Domestic production	1145
Recovery as byproduct	1138	Review by States	1146
Stocks	1139	Prices	1146
Prices	1139	Foreign trade	1146
Consumption and uses	1139	World production	1147

GENERAL SUMMARY

ALTHOUGH the world was going through a violent period of adjustment in 1946, most countries had one thing in common—they were trying to increase industrial production. Consequently, the demand for sulfur raw materials rose. To meet the high domestic requirements for native sulfur and a record export demand, production records were broken in the United States, and stocks were reduced. On the other hand, Italian native sulfur production was handicapped by high costs and foreign trade difficulties and therefore made only moderate progress toward the prewar level of output. Similarly, activity in the Japanese native sulfur industry was at a low level during its period of postwar adjustment. Although output was limited in many countries, the tonnage contributed by the United States was so large that world output of native sulfur attained a record in 1946. The rate of production of native sulfur has become so great that producers are accelerating their exploration programs to improve their reserve positions.

The production and international trade in pyrites began to swing slowly toward a more normal peacetime pattern in 1946. During the war shipping shortages and other difficulties greatly reduced the sales of some of the principal pyrite-exporting countries, such as Spain, Cyprus, and Portugal. Although such problems as monetary exchange, trade barriers, and stagnation of industry in some consuming areas were limiting factors, these countries have begun to recover their prewar markets. The pyrite output of countries such as Norway, France, Italy, and Germany that were under the control of the

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Axis during most of the war dropped to a low point in 1945, but in 1946 it had begun to increase with gradual revival of European industry. The same was true of Japan. In the United States the demand for sulfuric acid was so great that pyrites production reached record levels.

For many years the price of sulfur in the United States has been stable despite a substantial rise in wages and other costs. In 1946 the domestic price of crude sulfur was unchanged, but the export price was increased.

Salient statistics of the sulfur industry in the United States, 1935–39 (average) and 1943–46

	1935–39 (average)	1943	1944	1945	1946
Sulfur:					
Production of crude sulfur..long tons	2,175,057	2,538,786	3,218,158	3,753,188	3,859,642
Shipments of crude sulfur—					
For domestic consumption..do	1,420,236	2,296,452	2,865,397	2,914,603	2,939,140
For export..do	566,361	657,393	653,686	918,691	1,189,072
Total shipments..do	1,986,597	2,953,845	3,519,083	[1] 3,833,294	4,128,212
Imports:					
Ore..do	555				
Other..do	3,427	16,658	32	33	35
Exports of treated sulfur..do	16,374	25,079	21,546	23,971	56,748
Producers' stocks at end of year [2] do	3,560,000	3,800,000	3,500,000	3,500,000	3,200,000
Price of crude sulfur per long ton f. o. b. mines	$17.40	$16	$16	$16	$16
Pyrites:					
Production..long tons	544,144	802,384	788,530	722,596	813,372
Imports..do	433,485	256,308	180,843	186,507	182,893
Price of imported pyrites c. i. f. Atlantic ports, cents per long-ton unit	12–13	14	14	14	14
Sulfuric acid: Production of byproduct sulfuric acid (60° B.) at copper and zinc plants..short tons	727,172	1,228,098	1,160,023	1,084,891	922,127

[1] Corrected figure. [2] Stocks held at mines only.

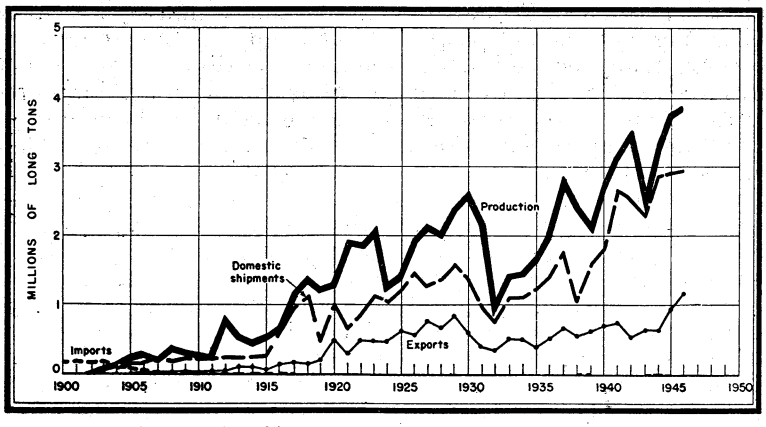

FIGURE 1.—Domestic production, shipments for domestic consumption, exports, and imports of crude sulfur, 1900–46.

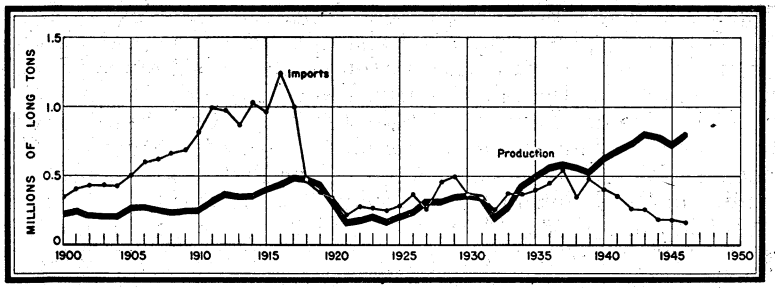

FIGURE 2.—Domestic production and imports of pyrites, 1900–46.

SULFUR

DOMESTIC PRODUCTION

Production of sulfur declined somewhat during the early months of 1946, but the trend was soon reversed. Thereafter, output increased rapidly and a new record of 3,859,642 long tons was attained—3 percent more than in 1945. Shipments from the mines, 8 percent greater than in 1945, also were the largest on record. In addition to the sulfur produced at Frasch-process mines, a modest tonnage of sulfur-bearing ore was mined in California, Colorado, Nevada, and Texas for agricultural purposes.

REVIEW BY STATES

Mines in Texas produced 77 percent and Louisiana nearly 23 percent of the native sulfur output of the United States in 1946.

Sulfur produced and shipped in the United States, 1942–46 [1]

Year	Produced (long tons)				Shipped	
	Texas	Louisiana	California and Utah	Total	Long tons	Approximate value
1942	2,885,621	570,345	4,720	3,460,686	3,128,559	$50,100,000
1943	1,908,581	630,205	----------	2,538,786	2,953,845	47,300,000
1944	2,582,238	635,920	----------	3,218,158	3,519,083	56,300,000
1945	2,969,778	783,410	----------	3,753,188	3,833,294	61,300,000
1946	2,975,472	884,170	----------	3,859,642	4,128,212	66,100,000

[1] In addition to the refined sulfur shown, native sulfur ore (10–70 percent S) for agriculture use was produced in Colorado and Texas in 1942–46 and in California and Nevada in 1946. Total shipments of this material were as follows, in long tons: 1942—1,590 ($16,000); 1943—2,572 ($26,215); 1944—1,639 ($8,950); 1945—1,426 ($12,170); 1946—6,344 ($95,531).

California.—Sulfur was produced at the Crater Claims and Fraction No. 1 mines in Inyo County by Roy Ketching and Bailey Miche, Big Pine, Calif.

Colorado.—General Agricultural Products Co. mined sulfur ore in Delta County.

Louisiana.—Output from the Grande Ecaille mine of the Freeport Sulphur Co. in Plaquemines Parish totaled 884,170 long tons in 1946, and production capacity was being expanded.

Nevada.—Production of sulfur in Humboldt County was reported by Oscar Streeter.

Texas.—The following companies operated in Texas in 1946: Duval Texas Sulphur Co., at Orchard Dome, Fort Bend County; Freeport Sulphur Co. at Hoskins Mound, Brazoria County; Jefferson Lake Sulphur Co., Inc., at Clemens Dome, Brazoria County, and at Long Point Dome, Fort Bend County; Texas Gulf Sulphur Co. at Boling Dome, Wharton County; and the Pecos Orla Sulphur Co. at Michigan Claims, Culberson County. The first production from the new mine of the Jefferson Lake Sulphur Co. at Long Point Dome was reported in June 1946. This property is operated under an unusual agreement whereby the producing company retains specified tonnages and delivers the remainder to the Texas Gulf Sulphur Co. Construction of a producing plant was initiated by the Texas Gulf Sulphur Co. at Moss Bluff Dome in Liberty County. The following table was compiled from information supplied by the Texas State Comptroller's Office.

Sulfur produced in Texas in 1946, by companies, in long tons

Company	First quarter	Second quarter	Third quarter	Fourth quarter	Total
Texas Gulf Sulphur Co	498,990	469,002	550,403	572,581	2,090,976
Freeport Sulphur Co	99,090	100,270	95,260	110,690	405,310
Jefferson Lake Sulphur Co., Inc	29,643	40,387	82,429	73,562	226,021
Duval Texas Sulphur Co	59,595	79,805	56,605	57,160	253,165
Total	687,318	689,464	784,697	813,993	2,975,472

RECOVERY AS BYPRODUCT

Sulfur occurs in many forms and, consequently, local conditions govern the choice of source. Some pyrites deposits are mined for their value as a source of sulfur. Elsewhere a large tonnage of pyrites is recovered as a byproduct flotation concentrate in the milling of copper and zinc ores. Similarly, "coal brasses" are obtained as a byproduct of coal washing. All these are included in the Pyrites section of this chapter.

The fumes evolved from copper and zinc smelters are at once a nuisance and a raw material. Where markets are available, large quantities of sulfuric acid are produced from them. The equivalent of 234,000 long tons of sulfur was recovered from this source in 1946. The following table shows the output of acid at smelters during the past 5 years.

Byproduct sulfuric acid (expressed as 60° B.) produced at copper, zinc, and lead plants in the United States, 1942–46, in short tons

	1942	1943	1944	1945	1946
Copper plants [1]	265,522	348,832	320,572	298,309	221,047
Zinc plants	695,242	879,266	839,451	786,582	701,080
	960,764	1,228,098	1,160,023	1,084,891	922,127

[1] Includes sulfuric acid produced as byproduct at a lead smelter.

Most of the elemental sulfur consumed in the United States is obtained as native sulfur, but some is also derived as a byproduct of industrial gases. Coke-oven, refinery, natural, and other industrial gases yield sulfur when treated by the Thylox, Ferrox, Nickel, or Sasco processes. United States Patent 2,403,451 was issued on the Sasco process in 1946. There were elemental sulfur-recovery plants in 10 States in 1946, and production totaled 34,990 long tons (calculated as 100 percent sulfur). Shipments totaled 37,499 long tons. Some of this material was marketed as paste containing 38 to 50 percent sulfur, but 91 percent was sold as brimstone.

Sulfur is also recovered from fuel gases in the form of hydrogen sulfide. The Phenolate, Phosphate, and Girbotol processes are used for this purpose, and the product is commonly converted to sulfuric acid or is burned as fuel. Hydrogen sulfide, recovered in three States in 1946, contained 18,366 long tons of sulfur.

STOCKS

During 1946 producers' stocks of sulfur declined 6 percent to 3,769,368 long tons, of which 3,191,039 tons were held at the mines.

PRICES

After a long period of stability sulfur prices began to increase in 1946. Trade journals continued to quote crude sulfur at $16 per long ton f. o. b. mines, but the export price at the port was, in some instances, increased per long ton from $17.50 to $20. Control of prices by the Office of Price Administration was terminated in November 1946.

CONSUMPTION AND USES

As shown in the accompanying tables, the consumption of native sulfur in the United States during the past 3 years has varied comparatively little. In 1946, however, total sales (including exports) apparently were about 6 percent greater than in 1945.

Apparent consumption of sulfur in the United States, 1942–46, in long tons

	1942	1943	1944	1945	1946
Shipments to consumers (apparent)	3,032,043	3,191,051	3,580,058	3,849,591	4,094,191
Imports	25,632	16,658	32	33	35
Total	3,057,675	3,207,709	3,580,090	3,849,624	4,094,226
Exports:					
Crude	568,249	657,393	653,686	918,691	1,189,072
Refined	17,030	25,079	21,546	23,971	56,748
Total	585,279	682,472	675,232	942,662	1,245,820
Apparent consumption	2,472,396	2,525,237	2,904,858	2,906,962	2,848,406

The pattern of sulfur consumption, by industries, has been estimated by Chemical Engineering as follows:

Sulfur consumed in the United States, 1942–46, by uses, in long tons

[Chemical Engineering]

Use	1942	1943	1944	1945	1946
Chemicals [1]	1,260,000	1,320,000	1,585,000	1,605,000	1,460,000
Fertilizer and insecticides	475,000	500,000	580,000	600,000	620,000
Pulp and paper	365,000	305,000	300,000	297,000	305,000
Explosives [1]	90,000	90,000	88,000	90,000	90,000
Dyes and coal-tar products	60,000	65,000	75,000	75,000	80,000
Rubber	35,000	45,000	55,000	58,000	65,000
Paint and varnish	70,000	80,000	90,000	94,000	105,000
Food products	6,000	7,000	7,000	7,000	7,000
Miscellaneous	110,000	120,000	140,000	135,000	215,000
Total	2,471,000	2,532,000	2,920,000	2,961,000	2,947,000

[1] To avoid disclosing estimated consumption of sulfur in direct war applications, such as military explosives, sulfur so used is included under "Chemicals."

Large tonnages of elemental sulfur are consumed in such uses as rubber compounding, insecticides, and paper, but about three-fourths is converted to sulfuric acid. Sulfuric acid has a multitude of uses and serves virtually every industry. Chemical Engineering has estimated consumption of sulfuric acid by the major consuming industries as follows:

Sulfuric acid (basis, 100 percent) consumed in the United States, 1944–46, by industries, in short tons

[Chemical Engineering

Industry	1944	1945	1946
Fertilizer	2,640,000	2,850,000	3,020,000
Petroleum refining	1,020,000	1,020,000	1,000,000
Chemicals and defense [1]	2,490,000	2,220,000	1,780,000
Coal products	625,000	600,000	510,000
Iron and steel	560,000	570,000	475,000
Other metallurgical	350,000	330,000	280,000
Paints and pigments	510,000	520,000	550,000
Industrial explosives	120,000	100,000	105,000
Rayon and cellulose film	450,000	495,000	556,000
Textiles	75,000	70,000	75,000
Miscellaneous	350,000	400,000	345,000
Total	9,190,000	9,175,000	8,696,000

[1] To avoid disclosing estimated consumption of acid in direct war applications, such as military explosives, acid so used is combined with "Chemicals."

In 1946 consumption of sulfuric acid is estimated to have been 5 percent lower than in 1945. However, the decline was principally in war uses, and there was a shortage of acid during the year in many areas. Some ordnance acid plants were sold to private companies. As shown in the accompanying table, the principal increase in consumption has been in fertilizer manufacturing. One difficulty that occasionally has limited movement of acid has been a shortage of tank cars. Sulfur, however, was provided in adequate quantities to supply all requirements.

An article outlining the present usage and value of application of sulfur as a fertilizer was published in 1946.[2]

As shown in the accompanying table of distribution of sulfuric acid production, the major sulfur markets are in the eastern and mid-western areas of the United States.

Distribution of sulfuric acid production in the United States, by market areas 1945–46

[Bureau of the Census]

Market area	1945		1946	
	Number of producing plants	New acid production (short tons)	Number of producing plants	New acid production (short tons)
New England	6	182,748	5	152,477
New York City	10	843,285	8	853,759
Philadelphia	12	657,267	8	642,003
Baltimore	9	876,708	7	804,953
Richmond-Norfolk	7	146,719	7	144,465
Southeast	15	657,883	14	827,642
South Atlantic	39	697,200	38	732,563
Cincinnati	8	279,568	8	292,490
Pittsburgh	11	661,479	9	633,050
Great Lakes	20	734,332	17	747,361
Chicago	14	731,273	12	715,639
St. Louis	6	514,268	5	558,497
Southwest Central	7	281,611	6	264,193
Gulf Coast	12	732,263	11	691,735
Western	16	690,466	16	588,336
Total	192	8,687,070	171	8,649,163

FOREIGN TRADE

In 1946 the foreign demand for American sulfur was considerably greater than had been anticipated, and exports reached a record total of 1,245,820 tons. Some producers were unable to fill all orders, and foreign sales combined with domestic tonnage that moves in coastwise ships were so great that they taxed the available loading facilities. The world-wide distribution of these shipments is shown in the accompanying table. Imports now are small, consisting principally of occasional receipts of high-grade material from Canada and sulfur ore from Mexico.

Sulfur imported into and exported from the United States, 1942–46

Year	Imports				Exports			
	Ore		In any form, n. e. s.		Crude		Crushed, ground, refined, sublimed, and flowers of	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
1942	------	------	25,632	$442,811	568,249	$10,942,703	17,030	$911,598
1943	------	------	16,658	343,083	657,393	12,521,502	25,079	1,384,016
1944	------	------	32	9,942	653,686	12,236,287	21,546	1,198,689
1945	------	------	33	10,197	918,691	16,643,121	23,971	1,634,943
1946	(1)	$20	35	11,226	1,189,072	21,589,966	56,748	2,624,873

[1] Less than 1 ton.

[2] Smith, A. M., Acidulating Soils with Sulfur: Fertilizer, vol. 105, No. 10, Nov. 16, 1946, pp. 9–11, 26, 28, 30

Sulfur exported from the United States, 1945–46, by countries

Country	Crude				Crushed, ground, refined, sublimed, and flowers of			
	1945		1946		1945		1946	
	Long tons	Value	Long tons	Value	Pounds	Value	Pounds	Value
North America:								
Canada	217,407	$4,502,387	248,811	$4,883,054	8,351,013	$203,156	8,492,849	$230,967
Central America	188	7,844	188	6,434	495,130	20,605	556,090	20,589
Mexico	3,189	73,473	2,726	69,308	2,314,512	64,715	2,899,826	63,091
Newfoundland and Laborador	11,069	190,139	10,376	168,532	4,000	230	3,960	177
West Indies	21,299	370,164	22,158	401,087	307,237	18,117	245,998	11,955
Other North America					1,634	98		
	253,152	5,144,007	284,259	5,528,415	11,473,526	306,921	12,198,723	326,779
South America:								
Argentina	16,155	290,790	27,400	488,931	948,035	18,135	420,987	36,529
Brazil	21,961	399,342	26,334	496,668	4,785,768	130,514	8,736,590	195,802
Chile					1,734	185	4,560	175
Colombia	610	14,542	1,002	22,891	441,080	13,866	611,840	19,280
Ecuador	18	1,180			230,329	7,462	105,877	7,766
Peru			74	2,223	884,936	33,983	772,598	15,708
Uruguay	3,500	63,000	12,922	229,994	1,748,649	31,433	4,528,448	76,690
Venezuela	4,000	67,648	11	487	162,339	5,349	274,682	6,969
Other South America	45	1,198	255	5,985	645,978	11,660	35,381	1,311
	46,289	837,700	67,998	1,247,179	9,848,848	252,587	15,490,963	360,230
Europe:								
Austria							922,200	15,677
Belgium and Luxembourg	45,185	779,015	67,555	1,268,813	3,264,555	74,230	1,390,742	30,865
Czechoslovakia			11,365	217,528	1,119,750	18,977	1,277,600	20,462
Eire					112,000	2,733	40,000	860
France	127,755	2,212,387	174,455	3,124,153	320,500	5,120		
Greece			125	6,377	1,054,700	21,811	41,359,398	648,896
Malta, Gozo, and Cyprus Islands			295	9,900	771,500	16,497	174,800	2,884
Netherlands			9,400	169,200	1,983,656	48,139	2,546,260	51,893
Norway					50,000	1,325	11,048	3,785
Sweden	3,252	56,892	13,705	243,515	69,180	2,418	1,181,473	34,156
Switzerland	13,599	245,268	6,520	117,770	1,236,530	29,235	1,078,690	23,482
United Kingdom	198,826	3,147,477	276,957	4,581,121	165,642	52,118	7,950	3,223
Yugoslavia	219	8,750	1,694	34,170	499,950	9,999	8,343,733	155,269
Other Europe	18,872	343,854	36,358	654,440	27,676	579	1,856,129	42,688
	407,708	6,793,643	598,429	10,426,987	10,675,639	283,181	60,190,023	1,034,140
Asia:								
Bahrein, State of	2,940	84,549			1,487,450	21,395		
Ceylon					1,765,680	39,129		
China			727	17,890	67,200	1,290	4,101,058	121,157
Hong Kong			760	23,227			1,306,480	36,840
India	16,897	344,785	46,051	929,370	491,642	209,251	12,109,421	219,541
Iran	15,153	368,950			1,270	61		
Palestine and Transjordan	2,081	42,274	786	17,669	440,344	9,964	997,672	14,362
Syria					1,156,700	27,160	55,100	1,127
Turkey			1,803	51,150	4,109,674	146,498	4,974,860	104,516
Other Asia	196	5,154	1	40	3,782	182	295,943	8,998
	37,267	845,712	50,128	1,039,346	9,523,742	454,930	23,840,534	506,541
Africa:								
Algeria	19,745	348,167	8,300	149,400	4,117,991	104,131	6,867,480	124,979
Belgian Congo					14,044	884	181,034	4,984
British East Africa			450	15,432	5,240	460	112,000	2,546
Egypt	694	22,484	841	19,394	4,619,867	115,963	2,031,342	37,570
French West Africa					11,340	390	958	48
Madagascar					6,100	335	66,798	2,185
Mauritius and Dependencies							220,000	5,300
Morocco, French					1,580,945	36,691	1,456,265	33,911
Mozambique	98	1,923			224,160	5,843	382,050	11,632

Sulfur exported from the United States, 1945–46, by countries—Continued

Country	Crude				Crushed, ground, refined, sublimed, and flowers of			
	1945		1946		1945		1946	
	Long tons	Value	Long tons	Value	Pounds	Value	Pounds	Value
Africa—Continued								
Nigeria					4,400	$488	1,200	$49
Union of South Africa	30,725	$525,828	28,072	$477,967	1,179,830	58,454	3,197,052	115,007
Other Africa	3,356	60,408	3,500	63,000	4,899	520	507,300	16,014
	54,618	958,810	41,163	725,193	11,768,816	324,159	15,023,479	354,225
Oceania:								
Australia	68,762	1,184,242	101,361	1,807,501	99,051	5,438	92,518	8,242
New Zealand	50,895	879,007	45,734	815,345	296,749	7,415	279,220	34,708
Other Oceania					9,705	312	40	8
	119,657	2,063,249	147,095	2,622,846	405,505	13,165	371,778	42,958
	918,691	16,643,121	1,189,072	21,589,966	53,696,076	1,634,943	127,115,500	2,624,873

WORLD PRODUCTION

Native sulfur is produced in many countries, but most of the output comes from comparatively few. In addition, a substantial tonnage of elemental sulfur is derived from pyrites and industrial gases. From the limited statistics available, it is estimated that world production of native and other elemental sulfur totaled about 4,400,000 long tons in 1946.

World production of native sulfur, 1939–46, by countries, in long tons [1]

[Compiled by P. Roberts]

Country [1]	1939	1940	1941	1942	1943	1944	1945	1946
Argentina			367	2,148	10,649	11,092	(2)	(2)
Bolivia (exports)	2,126	4,065	2,315	3,535	7,079	6,151	640	468
Chile	26,999	32,440	28,745	29,570	32,360	30,380	28,617	(2)
Ecuador	72		(2)		61	13	102	26
France (content of ore)	689	309	575	703	1,000	1,021	[3] 2,923	[3] 5,610
Greece		2,239	1,585	4,685	6,373	1,860	448	87
Guatemala	12	11	(3)	[4] 10	[4] 10		(2)	(2)
Italy (crude)[5]	350,208	325,473	294,288	220,808	[6] 91,773	[4] 37,000	[4] 80,000	140,765
Japan [7]	[8] 202,562	[8] 192,357	[9] 198,056	[8] 160,917	[8] 145,368	[8] 70,394	[8] 21,088	21,051
Mexico	(2)	(2)	(3)	[3] 26,115	[3] 4,400	[3] 5,100	[3] 7,100	(2)
Netherlands Indies	17,293	16,908	(2)	(2)	(2)	(2)	(2)	(2)
Palestine	829	1,358	3,365	[3] 713	(2)	(2)	(2)	(2)
Peru	571	610	935	1,126	564	601	1,197	394
Spain	3,770	3,560	6,230	5,000	5,511	6,280	4,840	(2)
Turkey [8]	2,560	[4] 2,600	[4] 2,600	[4] 2,600	3,326	3,348	3,097	376
United States	2,090,979	2,732,088	3,139,253	3,460,686	2,538,786	3,218,158	3,753,188	3,859,642
Total [10]	2,700,000	3,300,000	3,700,000	4,000,000	3,000,000	3,500,000	4,000,000	4,200,000

[1] Native sulfur believed to be produced also in China, Cuba, Egypt, Formosa, India, Iran, and U. S. S. R., but complete data are not available; however, estimates by senior author of this chapter are included in total.
[2] Data not available; estimate by senior author of this chapter included in total.
[3] Incomplete data.
[4] Estimate.
[5] In addition, following quantities of sulfur rock reported—1939: 19,568 tons; 1940: 15,552 tons; 1941: 17,802 tons; 1942: 30,734 tons. Similar data not available for later years.
[6] Production of Sicily for fiscal year ended July 31 of year stated.
[7] Preliminary data.
[8] Fiscal year ended March 31 of year following that stated.
[9] Data cited appear to be concentrates of 65–70 percent sulfur content.
[10] Estimated by senior author of this chapter.

Argentina.—Argentina is attempting to become self-sufficient in sulfur and has made considerable progress in that direction. Domestic production of native sulfur is encouraged by the Government through financial assistance and import limitations. A new acid plant, using the flue gases of a zinc furnace, was expected to provide 6,600 tons of acid in 1946.[3]

Chile.—Over a period of years, Campania Azufrera Aucanquilcha has accumulated a stock pile of 200,000 tons of autoclave residues containing about 40 percent sulfur. The company is installing a flotation plant to treat them. Minero del Pacifico and Aucanquilcha are said to be the only two companies now operating.

Costa Rica.—On the slopes of Volcano Poas several deposits of sulfur are worked intermittently, but they have not attained commercial importance. Imports of sulfur have ranged from 11 to 62 metric tons in recent years.

France.—From deposits at Malvezy, near Narbonne, the Société Languedocienne de Recherches et d'Exploitations Minières plans to produce 35,000 metric tons of sulfur ore that will be beneficiated by flotation.

Guatemala.—There is said to be little immediate prospect of materially increasing Guatemalan production of native sulfur—ordinarily 10 to 15 tons a year. Deposits are scattered, refining would be expensive, and transportation is poor. The present small output of crude sulfur is consumed by the chemical company that mines it. From 100 to 200 metric tons of refined sulfur are imported annually. About 90 percent of the sulfur consumed in Guatemala is used in sugar refining, 8 percent in chemical production, and 2 percent in pharmaceuticals.

India.—A unique deposit of sulfur near Kona, Kistna District, Madras Presidency, was being investigated by the Geological Survey of India. The sulfur is found in clay and silt in an area along the coast that is flooded by seawater during the monsoon months. The sulfur is said to be derived from soluble sulfates in the seawater through the action of bacteria. Sulfur content of the material varies from traces up to 45 percent, averaging about 10 percent, and the beds are about 2 feet thick. During the war, India produced sulfur at the Koh-i-Sultan mines in Baluchistan, but a decision to discontinue this operation has been reported.[4]

Italy.—During 1946 production of sulfur in Italy was held at a low level by monetary exchange problems and other difficulties. The official price of 9,500 lire per ton f. o. b. Sicilian ports was too high to attract foreign buyers, as the exchange rate was 225 lire to 1 dollar. Consequently, stocks of 60,000 tons accumulated and some mines closed down. The Italian producers indicated that they need either the allocation of a trade area to them or some revision of the price structure to enable them to regain their export markets.

Japan.—A report issued by the Allied Military Government[5] contained the following summary:

Sulfur is one of the most abundant natural resources of Japan. It is used chiefly in rayon and paper pulp manufacture and in the chemi-

[3] Foreign Commerce Weekly, vol. 23, No. 10, June 8, 1946, p. 34.
[4] Chemical Age, vol. 54, No. 1393, Mar. 9, 1946, p. 268.
[5] Natural Resources Section, General Headquarters, Supreme Commander for the Allied Powers, Sulfur Resources of Japan: Rep. 66, 1946, 29 pp.

cal industry. For many years it has been one of Japan's important export commodities. All of Japan's sulfur deposits are related to volcanic activity. Deposits occur throughout Japan, but the most important are in northern and central Honshu and in southwestern and northeastern Hokkaido. The most important sulfur-producing districts in Japan are (1) Matsuo, (2) Nagano Gumma, (3) Fukushima-Yamagata, (4) Kayabe-Kameda, (5) Horobetsu, and (6) Akan-ko-Musa-dake. Several other promising districts have not yet been developed. Sulfur deposits in Japan are divided into five types: (1) Sedimentary, (2) impregnation and replacement, (3) complex, (4) sublimation, and (5) sulfur flows. Complex deposits are the most important, followed by impregnation and replacement, and sedimentary deposits. Japan has adequate reserves to supply both domestic consumption and export needs for many years, and prospects for discovery of additional large reserves are excellent. Mining methods in the biggest sulfur mines in Japan compare favorably with those used in some of the mines of comparable size in the United States, although hand labor is used more widely in Japan. In the small mines, operations are primitive. Processing practices are simple, generally consisting only of crushing and sorting. In a few mines, flotation concentration is used before refining. Refining methods are crude, and recovery is fairly low.

Mexico.—The Mexican Gulf Sulphur Co. is said to have drilled four sulfur wells in the Province of Veracruz, and discovery of a major deposit of sulfur was reported.

U. S. S. R.—According to the Soviet press, a sulfur deposit, containing 2,000,000 tons, near Gaurdak in Turkmenia will be developed by the sulfur combine.

PYRITES

DOMESTIC PRODUCTION

After declining during the previous 2 years, production of pyrites in the United States in 1946 reached a new record, 1 percent above the high established in 1943.

Pyrites (ores and concentrates) produced in the United States, 1942–46

Year	Quantity		Value	Year	Quantity		Value
	Gross weight (long tons)	Sulfur content (percent)			Gross weight (long tons)	Sulfur content (percent)	
1942	720,363	42.6	$2,464,000	1945	722,596	41.0	$2,700,000
1943	802,384	42.0	2,844,000	1946	813,372	41.5	3,228,000
1944	788,530	42.2	2,598,000				

Owing to the competition of native sulfur, prices of pyrites are low, and in most areas in the United States production for sale on the open market is not attractive. Consequently, domestic production is largely by companies that can utilize the material locally without paying large transportation costs. In 1946, producing companies consumed 659,140 long tons, whereas they sold only 162,939 long tons.

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REVIEW BY STATES

California.—Output from the Hornet mine of the Mountain Copper Co., Shasta County, made California the third-largest pyrites-producing State in 1946.

Illinois.—At its Atkinson mine in Henry County, the Midland Electric Coal Corp. recovered 1,740 long tons of pyrites (coal brasses). As these occur in the coal as seams or lenses up to 4 inches in thickness, only moderate crushing is required to free them, allowing separation from washer waste, by jigs, of additional salable coal as well as byproduct lump pyrite.

Indiana.—Output of pyrite (coal brasses) by the Snow Hill Coal Corp. at the Talleydale mine, Vigo County, decreased in 1946.

Montana.—The Anaconda Copper Mining Co. recovered a substantial tonnage of pyrite in 1946 as a byproduct of its copper-plant operations at Anaconda, Deer Lodge County.

New York.—The St. Joseph Lead Co. shipped pyrites from the Balmat mine, St. Lawrence County, in 1946.

Pennsylvania.—The Bethlehem Steel Co. produced pyrites in Lebanon County.

Tennessee.—As in past years, Tennessee led all other States in the production of pyrites. Output came from mines operated by the Tennessee Copper Co. and was converted by that company to sulfuric acid and iron sinter.

Virginia.—Pyrites were produced by the General Chemical Co. at the Gossan mine to supply its sulfuric acid plant at Pulaski.

Wisconsin.—The Vinegar Hill Zinc Co. recovered pyrites in Grant County and converted them into acid.

PRICES

The price of Spanish pyrites, considering sulfur content only, is reported to have been approximately 14 cents per unit of sulfur, delivered to east coast ports. Price controls on pyrites were suspended by the Office of Price Administration on July 26, 1946.

FOREIGN TRADE

Imports of pyrites are much smaller than before the war, when they commonly ranged between 300,000 and 500,000 long tons. During the war receipts from Spain were small, being replaced by shipments from Canada and by substitution of native sulfur. Since 1942 imports from Canada have declined steadily, whereas those from Spain have slowly increased since 1944. However, Spain has been able to recover only a small portion of its American market. The accompanying table shows the statistics of pyrite imports during the past 5 years.

Pyrites, containing more than 25 percent sulfur, imported for consumption in the United States, 1942–46, by countries

Country	1942		1943		1944		1945		1946	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Canada	282,897	$1,313,295	197,750	$683,110	166,655	$302,892	137,238	$276,832	121,807	$269,179
Mexico	682	2,995	273	916			57	160		
Norway							1,150	1,725		
Spain	16,561	43,866	58,285	147,533	14,188	36,896	48,062	133,900	61,086	170,053
	300,140	1,360,156	256,308	831,559	180,843	339,788	186,507	412,617	182,893	439,232

As the major markets for foreign pyrites are in the East, imports from Canada enter through the Buffalo customs district and Spanish pyrite at Atlantic ports—principally Philadelphia. The accompanying table shows the import pattern for the past 5 years.

Pyrites, containing more than 25 percent sulfur, imported for consumption in the United States, 1942–46, by customs districts, in long tons

Customs district	1942	1943	1944	1945	1946
Buffalo	225,924	159,483	134,955	152,266	121,807
Maryland	12,561	10,357			
Massachusetts	82	69			
Michigan	29,163	28,051	29,865		
Montana and Idaho	366				
New York				16,891	
Ohio	1	71	1		
Philadelphia	6,102	47,928	14,188	17,350	61,086
St. Lawrence	80				
San Diego	732	273			
Vermont	15,440	8,562			
Virginia	4,000				
Washington	5,689	1,514	1,834		
	300,140	256,308	180,843	186,507	182,893

WORLD PRODUCTION

Pyrites are produced in a great many countries and before the war supplied well over half the world's sulfur. However, in 1946 the industries of the main pyrites-consuming countries (European and Japan) had not yet fully recovered. Consequently, output was limited by lack of markets caused by a variety of problems ranging from currency exchange difficulties to virtual industrial paralysis in some areas. Complete statistics are not available, but it is estimated that world production of pyrites totaled about 7,000,000 metric tons in 1946.

World production of pyrites (including cupreous pyrites), 1938 and 1943–46, by countries, in metric tons [1]

[Compiled by P. Roberts]

Country [1]	1938		1943		1944		1945		1946	
	Gross weight	Sulfur content	Gross weight	Sulfur content	Gross weight	Sulfur content	Gross weight	Sulfur content	Gross weight	Sulfur content
Algeria	48,250	21,230	25,590	10,236	32,905	13,491	30,132	12,354	40,359	16,547
Australia:										
New South Wales			34,571	16,460	35,337	16,765	(2)	(2)	(2)	(2)
Tasmania	51,084	25,300	33,736	16,765	29,604	14,631	40,813	20,000	37,893	18,570
Western Australia			10,353	4,267	24,082	9,957	67,571	(2)	79,032	(2)
Austria	(2)	(2)	1,435	570	3,516	1,400	2,180	800	3,823	1,332
Canada	40,464	20,300	258,162	126,505	226,859	110,470	206,595	99,974	(2)	87,864
Cyprus (exports)	523,574	256,551	13,195	6,334	11,451	5,496	101,681	48,807	260,314	124,950
Finland	102,979	44,281	110,490	48,472	127,660	58,430	110,320	48,541	(2)	(2)
France	147,850	67,005	207,260	79,844	112,908	43,875	146,625	58,650	187,228	74,891
Germany	465,241	176,191	1,397,065	529,390	(2)	(2)	(2)	(2)	(2)	(2)
Greece	244,000	118,605	3,860	1,853	4,380	2,102	6,510	3,125	80,140	38,467
India	(2)	(2)	(2)	(2)	594	(2)	(2)	(2)	(2)	(2)
Italy	930,312	386,079	[3] 465,253	[3] 214,000	(2)	(2)	102,508	49,000	397,333	182,770
Japan	[4] 2,122,128	[4] 912,515	[4] 1,167,710	[4] 502,115	[4] 716,188	[4] 307,961	[4] 118,750	[4] 51,063	474,842	204,182
Korea	132,614	53,146	213,604	85,442	246,003	98,401	(2)	(2)	(2)	(2)
Norway	1,027,776	446,939	808,779	344,703	750,405	319,409	247,465	106,369	537,916	(2)
Poland	92,209	36,883	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Portugal	558,327	251,250	109,994	[5] 49,500	130,131	[5] 58,560	170,967	[5] 76,900	314,976	[5] 141,740
Rumania	[5] 80,900	(2)	43,849	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Southern Rhodesia	27,065	10,900	35,065	[5] 14,000	34,177	[5] 13,670	33,465	[5] 13,390	25,413	[5] 10,160
Spain	2,727,003	[5] 1,145,341	881,150	[5] 370,100	512,249	[5] 215,100	899,760	[5] 377,900	792,587	[5] 332,900
Sweden	186,390	84,345	325,023	159,719	317,455	157,458	261,984	131,096	(2)	(2)
Tunisia	(2)	(2)	(2)	(2)	(2)	(2)	460	(2)	2,774	(2)
Turkey	(2)	(2)	(2)	(2)	(2)	(2)			300	(2)
Union of South Africa	31,017	13,947	37,030	16,195	36,155	15,859	38,556	16,745	38,044	16,553
U. S. S. R.	[5] 600,000	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
United Kingdom	4,351	(2)	9,759	(2)	10,395	(2)	11,468	(2)	10,926	(2)
United States	564,547	222,612	815,262	342,134	801,186	337,796	734,194	301,000	826,427	342,967
Uruguay	70	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Yugoslavia	150,402	67,681	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Total [6]	11,000,000	4,700,000	8,500,000	3,600,000	7,000,000	3,000,000	5,500,000	2,300,000	7,000,000	3,000,000

[1] In addition to countries listed, Belgium, Brazil, China, Czechoslovakia, Egypt, Eire, Hungary, and Iran produce pyrites, but production data are not available; however, estimates by senior author of this chapter are included in total.

[2] Data not available; estimate by senior author of this chapter included in total.

[3] January to June, inclusive.

[4] Preliminary data for fiscal year ended Mar. 31 of year following that stated.

[5] Estimate.

[6] Estimated by senior author of this chapter.

Cyprus.—During most of the war pyrite mines on Cyprus were unable to operate. In 1945 Cyprus Mines Corp. shipped 81,878 long tons from stock, and in May 1946 mining operations were resumed. In 1946 production totaled 103,132 long tons and shipments 167,636. Stocks have been depleted, and production is being increased gradually as European demand develops and labor becomes available.

India.—The Mysore Geological Survey has reported discovery of deposits of massive pyrites containing 50 percent sulfur near Chitaldrug, about 150 miles from Bangalore.

Japan.—During the war output decreased steadily to a low in 1945. In 1946 the downtrend was reversed and production totaled about 475,000 metric tons. A report on the pyrite industry in Japan (covering history, production statistics, geology, mining methods, and descriptions of mines) has been published by the Allied military government.[6] The summary presented was as follows:

Since 1935 Japan has ranked second only to Spain in production of pyrite and has developed reserves sufficient for about 40 years. Pyrite occurs throughout the Home Islands, but the most important deposits are on Honshu and Shikoku. Although numerous mines produce pyrite, most of the output comes from less than 35 mines; 2 of these produce about half of the national total. Mines producing pyrite concentrates as a byproduct of metal mining far outnumber pyrite-sulfur mines, but the latter group produces about 60 percent of the national total. Although production is hampered by difficulties, an output of 2,000,000 metric tons is anticipated by 1948. This level can be maintained for many years. All pyrite in Japan is used in the manufacture of sulfuric acid, of which the fertilizer industry is the largest consumer. Exports, which were fairly large after 1935, were used almost entirely by Japanese-controlled sulfuric acid plants in Japanese-occupied territory. Imports, which were small and sporadic, were chiefly from Canada and Formosa. Mining methods vary widely in pyrite mines. The larger mines employ modern methods; the smaller ones are, in many instances, inefficiently operated. In both groups, hand labor is used far more extensively than in the United States. Milling methods are simple, consisting of crushing and sizing. In large metal mines, modern gravity and flotation plants separate pyrite and metal concentrates.

Norway.—As much of Norway's pyrite is exported, production dropped when the European industrial demand collapsed in 1945. In 1946 Norwegian pyrite output rose to about half the normal rate.

Portugal.—In 1946 production of pyrite in Portugal was recovering from the wartime slump but was still substantially below the prewar level.

Spain.—With recovery of European industrial activity, demand for Spanish pyrite is increasing; but many barriers remain to be overcome, and production is still far below the prewar rate.

[6] Chidester, A. H., Pyrite Resources of Japan: Natural Resources Section, General Headquarters, Supreme Commander for the Allied Powers, Rept. 70, 1947, 22 pp.

Talc and Pyrophyllite [1]

By BERTRAND L. JOHNSON AND F. M. BARSIGIAN

GENERAL SUMMARY

MINE PRODUCTION of talc, pyrophyllite, and ground soapstone made a new high record in 1946, according to reports by producers. All-time records were also made in both total quantity and value of these commodities sold or used (see fig. 1.) Total imports were much larger in 1946 than in 1945, both in quantity and value, owing to the increased quantity of ground materials brought

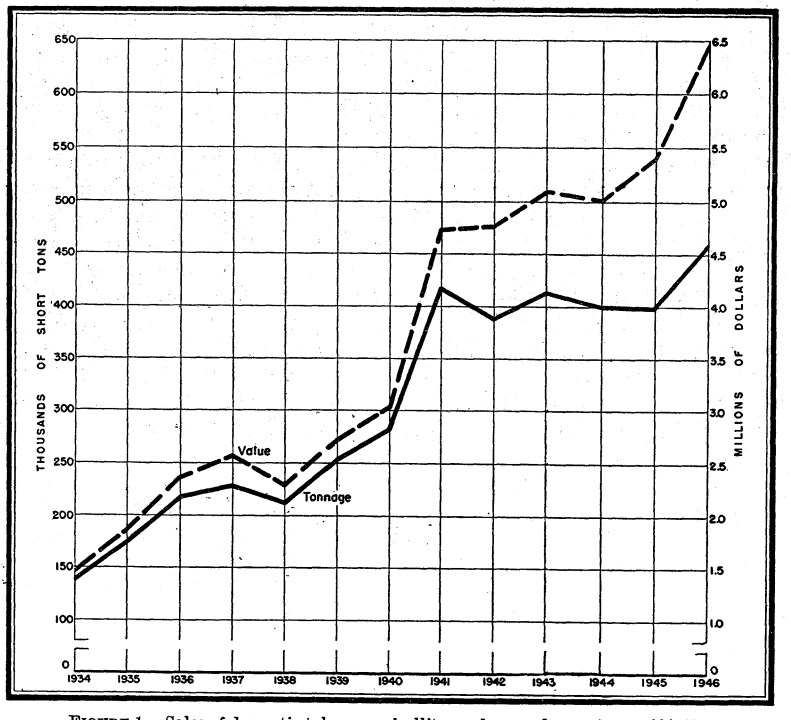

FIGURE 1.—Sales of domestic talc, pyrophyllite, and ground soapstone, 1934–46.

in. Exports of "talc, steatite, soapstone, and pyrophyllite, crude and ground" increased both in quantity and value in 1946, and exports of "powders—talcum (in packages), face, and compact" were over a million dollars greater in value in 1946 than they were in 1945.

[1] Including data for ground soapstone.

Pyrophyllite (a hydrous aluminum silicate) is included with talc (a hydrous magnesium silicate) in this chapter because of its resemblance to talc in certain physical properties and because it is interchangeable with talc in some uses, although certain specialized uses for pyrophyllite have been developed in recent years. Statistical details on the mining and sales of pyrophyllite are given in footnotes of the salient statistics and sales tables.

Salient statistics of the talc, pyrophyllite,[1] and ground-soapstone industries in the United States, 1945–46

	1945		1946	
	Short tons	Value	Short tons	Value
Mined:				
Sold crude	[2] 35,979	[2] $367,488	36,963	$348,484
Used by producers	[2] 378,471	[3]	423,591	[3]
	[2] 414,450	[3]	460,554	[3]
Sold by producers:				
Crude	[2] 35,979	[2] 367,488	36,963	348,484
Sawed and manufactured	[2] 733	[2] 182,904	756	227,751
Ground	[2] 361,672	[2] 4,856,843	419,347	5,869,109
	[2] 398,384	[2] 5,407,235	457,066	6,445,344
Imports for consumption: [4]				
Crude and unground steatite and French chalk	385	20,980	8	530
Cut and sawed	122	17,618	34	4,856
Ground, washed, or pulverized	6,192	63,260	18,407	394,881
	6,699	101,858	18,449	400,267
Exports:				
Talc, steatite, soapstone, and pyrophyllite, crude and ground	11,141	279,178	16,373	394,799
Powders—talcum (in packages), face, and compact	[5]	2,276,758	[5]	3,517,827
		2,555,936		3,912,626

[1] In 1945: Mined, 77,716 short tons. Sold—crude, 6,215 tons, $38,166; ground, 71,379 tons, $613,034; total, 77,594 tons, $651,200. In 1946: Mined, 97,765 short tons. Sold—crude, 10,716 tons, $85,002; ground, 85,835 tons, $913,301; total, 96,551 tons, $998,303 (exclusive of pinite).
[2] Revised figure.
[3] Data not available.
[4] Exclusive of "Manufactures, n. s. p. f., except toilet preparations," as follows: 1945: $63; 1946: $15,687; quantities not available.
[5] Quantity not recorded.

Twelve States reported sales of talc, pyrophyllite, or ground soapstone in 1946, one less than in 1945, no talc being reported as sold from New Mexico. The greater part of the total sales in 1946 was made in the Eastern States.

Several publications dealing with talc or soapstone deposits have appeared recently. The Geological Survey issued in November 1945 a two-sheet uncolored outcrop map covering the Gouverneur talc district, St. Lawrence County, N. Y., on a scale of 400 feet to the inch, from Sylvia Lake near Balmat on the west to Edwards at the eastern end of the talc area. The New York talc deposits were discussed by Broughton [2] in a recent article. Teague [3] described the deposits, mining methods, and subsequent treatment of the mined talc in the four mines of the Chatsworth district in northern Georgia.

[2] Broughton, J. G., Geology of Ceramic Materials in New York State: New York Acad. Sci., vol. 7, 1945, pp. 107–108.
[3] Teague, K. F., Georgia Talc Industry Helped by Geologic Study: Eng. and Min. Jour., vol. 147, No. 11, November 1946, pp. 63–65.

He considers that the talc deposits occur as lenses in association with dolomitic and chloritic schists which have been intruded and included in a pre-Cambrian granite-gneiss, the talc appearing to have been formed by the alteration of impure dolomitic limestone of pre-Cambrian age. Barnes [4] described soapstone lenses, in the schists and gneisses of the central mineral region of Texas, consisting chiefly of talc and tremolite, with minor amounts of chlorite, magnetite, calcite, and serpentine. The soapstone is considered to be the product of the alteration of tremolite schist formed by the metamorphism of impure dolomites. The Reed talc mine, Esmeralda County, Nev., was mapped by the Geological Survey.

SALES

The quantity of domestic talc, pyrophyllite, and ground soapstone sold or used in 1946 was considerably greater than in 1945, according to reports of the producers to the Bureau of Mines. This output—457,066 short tons—was a new record, exceeding the former record set in 1941 by over 40,000 tons. The total value of $6,445,344 in 1946 was over a million dollars greater than in 1945 and was an all-time high. The average value per ton rose from $13.57 (revised) in 1945 to $14.10 in 1946.

Talc, pyrophyllite,[1] and ground soapstone sold by producers in the United States, 1942–46, by classes

Year	Crude			Sawed and manufactured		
	Short tons	Value at shipping point		Short tons	Value at shipping point	
		Total	Average		Total	Average
1942	[2] 33,837	[2] $303,166	[2] $8.96	1,505	$370,631	$246.27
1943	30,200	289,563	9.59	1,669	316,973	189.92
1944	[2] 45,654	[2] 514,476	[2] 11.27	938	223,924	238.72
1945 [3]	35,979	367,488	10.21	733	182,904	249.53
1946	36,963	348,484	9.43	756	227,751	301.26

Year	Ground			Total		
	Short tons	Value at shipping point		Short tons	Value at shipping point	
		Total	Average		Total	Average
1942	352,621	$4,080,279	$11.57	387,963	$4,754,076	$12.25
1943	380,999	4,514,878	11.85	412,868	5,121,414	12.40
1944	352,271	4,279,062	12.15	398,863	5,017,462	12.58
1945 [3]	361,672	4,856,843	13.43	398,384	5,407,235	13.57
1946	419,347	5,869,109	14.00	457,066	6,445,344	14.10

[1] In 1945: Crude, 6,215 tons, $38,166; ground 71,379 tons, $613,034; total, 77,594 tons, $651,200. In 1946: Crude, 10,716 tons, $85,002; ground, 85,835 tons, $913,301; total, 96,551 tons, $998,303.
[2] Includes pinite from Nevada.
[3] Revised figures.

[4] Barnes, V. E., Soapstone and Serpentine in the Central Mineral Region of Texas: Univ. Texas Pub. 4301, 1945, pp. 55–91.

Sales by States.—New York in 1946 was still the leading producing State by a considerable margin, with North Carolina in second place. Increased sales were reported in many of the States in 1946. Sales of the leading States—California, Georgia, and North Carolina—reached new levels. Total sales of pyrophyllite, most of which comes from North Carolina, increased 24 percent in 1946 over 1945.

Talc, pyrophyllite, and ground soapstone, sold by producers in the United States, 1945–46, by States

State	1945 [1]		1946	
	Short tons	Value	Short tons	Value
California	67,321	$1,254,143	78,170	$1,434,978
Georgia	32,433	296,163	36,410	380,477
Maryland, Pennsylvania, and Virginia	34,084	329,631	42,505	424,334
Nevada	11,780	185,059	7,589	141,180
North Carolina	78,369	682,510	87,718	976,524
Vermont	63,574	752,583	75,144	843,247
Washington	2,804	33,458	5,084	38,051
Montana, New York, and Texas [2]	108,019	1,873,688	124,446	2,206,553
	398,384	5,407,235	457,066	6,445,344

[1] Revised figures. [2] Includes New Mexico in 1945.

CONSUMPTION AND USES

Five industries—paint, rubber, roofing, ceramics, and insecticides—consumed 77 percent of the sales of domestically produced talc, pyrophyllite, and ground soapstone in 1946, according to reports from the producers. Increases were reported in sales to the paint, rubber, roofing, ceramics, insecticides, and paper industries. Especially notable were the increases in the ceramic and insecticides industries. Consumption in paint was easily the leading use with 23 percent of the total. The rubber, ceramics, and insecticides industries were close competitors for second place, each taking about 14 percent of the total.

Estimated distribution of talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1945–46, by uses

Use	1945 [1]		1946	
	Short tons	Percent of total	Short tons	Percent of total
Paint	103,583	26	103,828	23
Rubber	63,758	16	65,980	14
Roofing	46,783	12	54,581	12
Ceramics	37,889	10	62,389	14
Insecticides	37,012	9	64,954	14
Paper	28,138	7	32,300	7
Toilet preparations	21,543	5	17,111	4
Foundry facings	7,072	2	7,045	2
Crayons	336	[3]	306	[3]
Other uses [4]	23,506	6	24,803	5
Unclassified	28,764	7	23,769	5
	398,384	100	457,066	100

[1] Revised figures. [3] Less than 0.5 percent.
[4] Asphalt filler, refractory, textile, plaster, plastics, agriculture, and miscellaneous uses.

Several articles on the use of talc in the ceramic industry appeared recently. A recent article [5] suggested the addition of talc to glass-pot

[5] Ceramic Industry, It Worked With Saggers—Why Not With Glass Pots?: Vol. 46, No. 3, March 1946, pp. 74–76.

batches and its use in saggers was stated to lower the expansion coefficient, tighten the body, and increase strength. Gingold [6] gave a short review of vitrified electrical insulating materials developed and used during recent years, and in a later article [7] discussed the decrease in modulus of rupture and compression strength of hollow cylinders with equal outside diameter as inside diameter is increased and explained this fact by the assumption that the natural fire coating acts as a glaze under tension. Gleason [8] presented a discussion of the use of steatite in electrical insulators for high-frequency purposes. He called attention to the fact that the excellent dielectric properties of steatite are due to the formation of clinoenstatite crystals in the heat treatment of the steatite talc, and that their interlocking structure imparts high mechanical strength.

PRICES

Prices of ground domestic talc per ton, carlots, bags, f. o. b. works, quoted by Oil, Paint and Drug Reporter in the early part of 1946 were the same as for several years. These prices were:

Talc, domestic, ordinary, ground	$14. 50–$24. 50
California	17. 50– 43. 00
New York, fibrous, ground, off color, coarse	13. 00
New York, fine, 325-mesh, 93–94 percent	13. 00– 18. 00
New York, fine, 325-mesh, 98–99.5 percent	15. 25– 19. 25
New York, fine, 325-mesh, 99.85–99.95 percent	17. 00– 21. 00
Pennsylvania	11. 00– 13. 50
Vermont	14. 00
Talc, imported, Canadian	24. 00– 30. 00

During the latter part of 1946, however, slight changes occurred in some of these prices, and on December 30, 1946, the range in prices of California talc had changed to $22 to $30; New York fibrous talc, ground, off color to $15.50; and Canadian talc to $35 to $44.50 per ton. The other quotations were unchanged.

Prices for pyrophyllite were the same in 1946 as in 1944 and 1945. According to Oil, Paint and Drug Reporter these were: Standard, 200-mesh, carlots, bulk, mines, per ton $10 to $11.50; 325-mesh, same basis, $13 to $13.90; No. 3, 200-mesh, carlots, bulk, mines, per ton $9.50; No. 3, 325-mesh, same basis, $11.50. Pyrophyllite in paper bags was $1.50 per ton extra.

The average values of all grades of talc, pyrophyllite, and ground soapstone in the past 5 years, as reported to the Bureau of Mines by producers, are given in the table under "Sales."

Price controls of talc, pyrophyllite, and ground soapstone by the Office of Price Administration in 1946 covered only the agricultural grades, which form but a very small percentage of the total consumption of these materials. Controls on industrial grades had been suspended by OPA October 16, 1945 (OPA Supplementary Order 129, amendment 2, sec. 10 (a): 10 F. R. 12768). The remaining controls (those on agricultural grades) were removed in May 1946.

[6] Gingold, J. J., Survey of Ceramic Insulating Materials: Ceram. Ind., vol. 46, No. 3, March 1946, pp. 72–74.

[7] Gingold, J. J., Mechanical Abnormalities of Extruded Steatite: Jour. Am. Ceram. Soc., vol. 29, No. 8, August 1, 1946. pp. 228–230.

[8] Gleason, J. M., Steatite for High-Frequency Insulation: Jour. Brit. Inst. Radio Eng., vol. 6, 1946, pp. 20–32.

FOREIGN TRADE [9]

Imports.—A marked increase in both the total quantity and value of "talc, steatite or soapstone, and French chalk" imported for consumption in the United States occurred in 1946, the quantity imported being nearly triple the 1945 figure and the value nearly four times that of the previous year. These increases were due to the much larger imports of ground talc, which more than counterbalanced decreased imports of crude and unground, and cut and sawed material. As usual, the ground material constituted the major part of the imports. The value of the imports of "Manufactures, n. s. p. f., except toilet preparations" was many times greater than in recent years due to large imports from China. Italy was the principal source of the ground imports, with Canada falling to second place (see fig. 2).

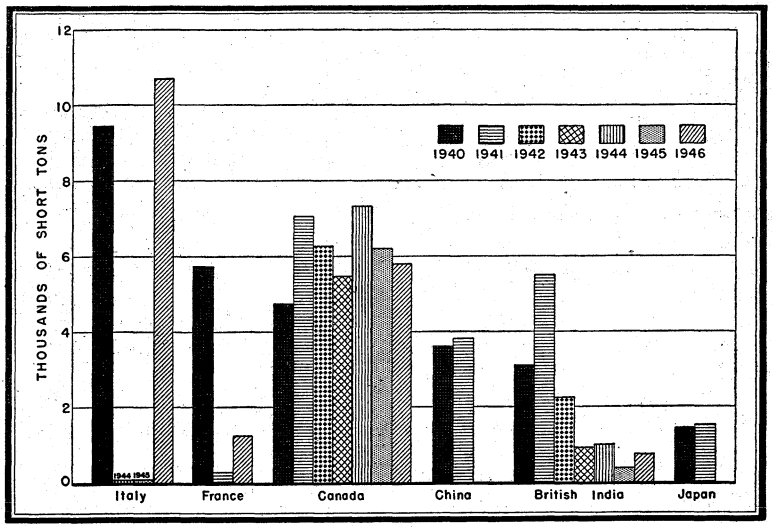

FIGURE 2.—Talc, steatite or soapstone, and French chalk imported for consumption in the United States, 1940–46, by leading countries.

Talc, steatite or soapstone, and French chalk imported for consumption in the United States, 1942–46, by classes

Year	Crude and unground		Ground, washed, powdered, or pulverized, except toilet preparations		Cut and sawed		Total		Manufactures, n. s. p. f., except toilet preparations (value)
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	
1942	286	$5,753	8,492	$94,687	(1)	$36	8,778	$100,476	$2,704
1943	408	12,195	6,201	64,815	1	40	6,610	77,050	20
1944	696	60,137	7,650	88,207	132	20,639	8,478	168,983	25
1945	385	20,980	6,192	63,260	122	17,618	6,699	101,858	63
1946	8	530	18,407	394,881	34	4,856	18,449	400,267	15,687

[1] Less than 1 ton.

[9] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Talc, steatite or soapstone, and French chalk imported for consumption in the United States, 1945–46, by classes and by countries

Country	Crude and unground		Ground, washed, powdered, or pulverized except toilet preparations		Cut and sawed		Total		Manufactures, n. s. p. f., except toilet preparations (value)
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	
1945									
Canada			6,192	$63,260	25	$7,112	6,217	$70,372	
China									$63
India and Dependencies	353	$16,728			56	5,000	409	21,728	
Italy	32	4,252			41	5,506	73	9,758	
	385	20,980	6,192	63,260	122	17,618	6,699	101,858	63
1946									
Canada			5,787	63,911	(1)	1	5,787	63,912	
China									15,634
France			1,241	26,656			1,241	26,656	
Greece			(1)	15			(1)	15	5
Hong Kong									29
India and Dependencies	8	530	714	20,920	22	1,179	744	22,629	
Italy			10,665	283,379	12	3,676	10,677	287,055	
United Kingdom									19
	8	530	18,407	394,881	34	4,856	18,449	400,267	15,687

[1] Less than 1 ton.

Exports.—Another new record in the quantity of "Talc, steatite, soapstone, and pyrophyllite, crude and ground" exported from the United States was made in 1946, surpassing the previous record of 1945 by over 5,000 short tons. The value of these exports increased from $279,178 in 1945 to $394,799 in 1946, which was also a new record. The value of the exports of "Powders—talcum (in packages), face, and compact" increased nearly 1¼ million dollars over 1945.

Talcum and other powders exported from the United States, 1942–46

Year	Talc, steatite, soapstone, and pyrophyllite, crude and ground		Powders—talcum (in packages), face, and compact (value)
	Short tons	Value	
1942	9,246	$191,900	$678,313
1943	10,693	236,268	756,024
1944	10,709	229,293	1,328,890
1945	11,141	279,178	2,276,758
1946	16,373	394,799	3,517,827

WORLD PRODUCTION

The production of talc, pyrophyllite, and ground soapstone in various countries during recent years is shown in the accompanying table.

World production of talc, pyrophyllite, and soapstone, 1940–46, by countries, in metric tons [1]

[Compiled by P. Roberts]

Country [1]	1940	1941	1942	1943	1944	1945	1946
Argentina	1,168	1,975	4,770	3,557	3,421	(2)	(2)
Australia:							
New South Wales	754	1,153	1,454	1,814	1,874	1,776	(2)
South Australia	1,349	2,972	2,577	3,336	3,930	3,037	3,727
Tasmania					4	155	50
Western Australia			308	74	266	(2)	396
Austria	26,913	35,956	42,933	57,639	44,628	4,470	21,429
Canada	21,583	31,417	27,096	23,735	29,571	24,574	29,167
Chile	(2)	(2)	(2)	276	935	477	(2)
China	73,000	76,000	80,000	(2)	(2)	(2)	(2)
Egypt	2,212	5,229	1,875	2,054	4,265	3,868	4,760
Finland	(2)	(2)	(2)	(2)	(2)	75	(2)
France	(2)	(2)	50,150	48,300	26,720	42,461	66,477
Germany	9,449	12,170	13,526	(2)	(2)	(2)	(2)
India	30,186	26,571	32,262	16,700	21,735	22,704	(2)
Indochina, French	305	370	260	360	530	(2)	(2)
Italy	71,443	73,475	80,462	(2)	(2)	46,287	(2)
Japan							200
Kenya	(2)	(2)	(2)	(2)	123	67	(2)
Korea (Chosen)	60,227	(2)	(2)	(2)	50,226	(2)	(2)
Madagascar	(2)	(3)	(3)	39	(3)	(2)	(2)
Morocco, French	(2)	(2)	(2)	(2)	(2)		
Newfoundland	284	508	1,580	2,439	224	711	660
New Zealand	(2)	(2)	15	63	25		
Norway	17,028	29,059	30,174	30,454	(2)	(2)	(2)
Rumania	1,556	3,347	3,052	1,609	(2)	(2)	(2)
Spain [4]	28,643	29,148	36,497	14,238	10,470	19,319	(2)
Sweden	7,569	5,233	6,153	5,335	5,512	7,806	(2)
Tanganyika	6	(2)	(2)	(2)	(2)	(3)	(2)
Union of South Africa	1,671	2,458	1,985	5,344	2,875	1,947	2,609
United Kingdom	1,074	4,532	2,231	2,815	2,829	(2)	(2)
United States [5]	255,258	377,722	351,952	374,546	361,841	361,406	414,641
Uruguay	[6] 1,699	2,111	4,588	1,985	2,257	1,823	1,818
Total [7]	664,000	822,000	826,000	747,000	706,000	690,000	770,000

[1] In addition to countries listed, talc or pyrophyllite is reported produced in Brazil, Bulgaria, Greece, and U. S. S. R., but data on production are not available.
[2] Data not available.
[3] Less than 1 ton.
[4] Includes steatite, as follows—1940: 17,191; 1941: 18,948; 1942: 24,859; 1943: 9,741; 1944: 7,369; 1945: 15,577.
[5] Talc, pyrophyllite, and ground soapstone sold by producers; includes also pinite in 1940–42 and 1944.
[6] Exports.
[7] Excludes estimates for countries listed in footnote 1.

Canada.—The Canadian talc and soapstone industry in 1945 was described as follows:[10]

Producers' shipments of crude and milled talc and soapstone totaled 27,088 tons valued at $294,888 in 1945 compared with 32,597 tons at $357,249 in 1944. Operators in Quebec shipped 14,225 tons of talc and soapstone worth $153,694 and mines in Ontario sold 12,863 tons, mostly high-grade talc, valued at $141,194.

Imports of talc and soapstone in 1945 amounted to 6,389 tons at $131,863, and exports of talc totaled 7,363 tons valued at $100,114.

The 5 active firms in the industry in 1945 employed 103 workers to whom $134,782 were paid in salaries and wages. Fuel and electricity cost $27,978 and process supplies for the mines cost $49,266.

The Bureau of Mines, Ottawa, has given the following information with regard to the talc industry:

"Canada is self-sufficient in respect to most of the grades of ground talc needed for its industrial requirements, and there is considerable surplus for export. It also produces most of the sawn dimension soapstone and talc crayons used, but is dependent on imports, obtained mainly from the United States, for certain special qualities of ground talc demanded by the ceramic, paint, and cosmetic trades.

"Ground talc has a wide variety of uses, but much the greater part of the out-

[10] Deir, A. R., The Talc and Soapstone Industry in Canada, 1945: Canada Department of Trade and Commerce, Dominion Bureau of Statistics, Mining, Metallurgical, and Chemical Statistics, Ottawa, Canada, 1947, 5 pp.

put is employed in the paint, roofing, paper, rubber, and ceramic industries. It is used, also, in foundry facings, bleaching fillers for textiles, cosmetics and pharmaceuticals, soaps and cleansers, insecticides, polishes, plastics, and for rice polishing.

"Soapstone, a soft greenish rock containing a high percentage of talc, is used extensively in the form of sawn blocks and bricks for lining the alkali recovery * * * furnaces and kilns of Kraft pulp and paper mills. It is also used for brick and slab liners for fireboxes, stoves and ovens, and for switchboard panels, laboratory benches, etc. Considerable quantities of soapstone quarry and sawing waste are ground and marketed as low-grade talc to the rubber, roofing, foundry, and other trades."

Additional statistical details are contained in the report as well as the names and addresses of the five operating firms.

Tin

By C. E. NIGHMAN AND J. B. UMHAU

	PAGE		PAGE
General summary	1159	Consumption	1165
Salient statistics	1159	Stocks	1166
Government tin operations	1161	Prices	1167
Government controls	1162	Foreign trade	1169
Domestic tin investigations	1162	World review	1172
Domestic production	1163	International controls	1172
Mine output	1163	World mine production	1173
Smelter output	1163	World smelter production	1174
Secondary tin	1164	Review by countries	1174

GENERAL SUMMARY

AN AFTERMATH of the Japanese conquest of Malaya and the Netherlands East Indies persisted through a fifth year, 1946, in the form of a world tin shortage. The disappointingly slow progress in rehabilitation of the Far Eastern tin areas, combined with tremendous demand, enforced a continuation of international control over the distribution of available supplies. World mine output rose about 3 percent over the long-time low of 1945 to 89,000 long tons, or roughly half the estimated needs. Drafts on stocks of the United Kingdom and the United States, plus a part of the tin recovered from Japanese operations—about 25,000 tons in all—helped ameliorate the stringency. Near the end of the year arrangements were made for the sale and distribution of about 15,000 tons (tin content) of materials left from Japanese operations in Siam. Production expansion is expected from all parts of the Far East in 1947, but late estimates indicate that the world total may not meet requirements until 1949.

Salient statistics for tin in the United States, 1925–29 (average) and 1942–46

	1925–29 (average)	1942	1943	1944	1945	1946
Production—						
From domestic mines, long tons	24	6.3	6	5		
From domestic smelters [1], do		16,168	21,489	30,884	40,475	43,500
From secondary sources, do	30,600	33,900	33,800	29,100	31,400	24,700
Imports for consumption:						
Metal, do	78,009	26,753	11,919	13,338	8,493	15,520
Ore (tin content), do	175	28,933	21,857	35,548	33,527	38,070
Exports (domestic and foreign), do	1,740	409	1,770	843	882	881
Monthly price of Straits tin at New York:						
Highest, cents per pound	70.67	(2)	(2)	(2)	(2)	70.00
Lowest, do	39.79					[2] 52.00
Average, do	56.64					54.58
World mine production, long tons	163,000	122,000	142,000	102,000	86,000	89,000

[1] Including tin content of ores used direct to make alloys.
[2] Ceiling price, 52 cents.

For 5 years there has been no world market price for tin. In 1946 the general price situation became greatly confused owing to the spread between buying and selling levels, complicated by consummation of retroactive purchase agreements at higher figures, price differentials between internal and external markets, and black market prices for small quantities of uncontrolled metal. At the year end the price of tin was 30 to 40 percent above the 1941 level, but this represented an increase substantially less than for copper, lead, or zinc over the same period. In the United States the internal price for Grade A tin was retained at the former ceiling of 52 cents a pound until early November, when, following the revocation of price and wage controls, it advanced to 70 cents and so remained to the end of the year.

The International Tin Control scheme came to an end December 31, 1946. A step toward replacement was developed at a meeting of representatives of producing and consuming nations in London in October. The principal outcome was a recommendation to form a Tin Study Group to be allied with the International Trade Organization proposed by the United States in 1945. Invitations were sent to the several interested nations asking participation in such a group. Final acceptances were received early in 1947, and an organizational meeting was held in Brussels in April.

There was no recorded domestic production of ore or concentrates in 1946. The Longhorn smelter set a new high, with an output of 43,468 long tons of pig tin. In the highest month it was near an annual rate of 47,000 tons but declined to about a 38,000-ton level owing to the dearth and low grade of raw material. Consumption of primary tin, notwithstanding easing of various control measures, was at 54,627 long tons, 2 percent below that in 1945. In the United Kingdom, on the other hand, the use (25,600 tons) was 56 percent greater than in the preceding year. In the United States the use pattern more nearly approached that of the prewar period. Tin plate took 48 percent of the virgin metal; solder 25 percent—a very high ratio; brass and bronze 9 percent; and babbitt nearly 8 percent. Imports of metal were 83 percent more than in 1945 and included tin from Japanese sources sent to the United States for grading and analysis before being made available for distribution by the Combined Tin Committee. The tin content of concentrates received during 1946 increased 14 percent compared with 1945 and was, in the main, attributable to larger receipts from Bolivia (2,584 tons) and reappearance of Netherlands East Indies as a source (2,206 tons). Tin plate and terneplate, constituting the principal export, dropped over 24 percent from 1945. The decline in foreign shipments was to a large extent due to a shortage in black plate, in part to a result of work stoppages in the steel and coal industries, and in part to the heavy domestic demand for containers.

Total stocks, excluding the Japanese tin mentioned above, dropped 12 percent to 84,000 tons, divided as follows: Industry, 28,200; Government, including 12,140 tons in sterilized stocks, 31,100 tons in metal and 24,700 tons in concentrates. Consumers' pig-tin stocks covering about 3 months' needs would permit little or no reduction, and only about 17,000 tons of the Government-owned supplies were

left available for distribution at the year end. Inasmuch as the new supply outlook was unfavorable, it became evident that use controls would have to be continued for another year at least.

GOVERNMENT TIN OPERATIONS

Under terms of the Civilian Production Administration order governing imports of strategic materials (M–63), tin imports continued to be channeled through Government hands throughout 1946. In March 1946 the original authority to buy ores and concentrates for the Government-owned smelter was reaffirmed. The Reconstruction Finance Corporation was permitted to purchase such materials without time limit. The Corporation was also freed from the provisions of the Emergency Price Control Act of 1942 that forbade loss or subsidized sales. The power actually ceased with expiration of that legislation on June 30 but was revived July 25 with approval of an act restoring the Office of Price Administration. Therein it was provided that, to June 30, 1947, the Reconstruction Finance Corporation might take any losses accruing through sales at the ceiling prices of tin obtained from smelting of ores or concentrates. This was interpreted to cover also the difference between cost and sales price of purchased metal. Wage and price controls were lifted by Executive and OPA order effective November 10. Thereafter the selling price (see section on Prices) was set from month to month on the basis of trade journal quotations and presumably would approximate the cost. At least, the loss in the ceiling-price period, estimated to have been about $1,500,000 monthly, would be substantially reduced.

Several contracts for purchase of tin and concentrates were concluded during the year. These included acquisition of tin and concentrates from the Netherlands East Indies and tin from the United Kingdom and China. The principal arrangement was again made with Bolivia. The supplemental 1-year contract to the original 5-year agreement expired June 30, 1946. Thereunder the prices for the first and second quarters of 1946 were, respectively, 60.5 and 58.5 cents a pound payable tin content plus a 1.5-cent production bonus, f. o. b. Chilean or Peruvian ports. Negotiations for renewal were undertaken in the spring but unsuccessfully, largely because of a wide disparity between the offered and demanded price and the period to be covered. The new agreement was announced in mid-August but was not formally ratified by Bolivia until September 13. It was made retroactive to January 1 and to run to December 31,1946. For the first half year the base price was 62.5 cents a pound payable tin, f. o. b. Chilean or Peruvian ports, plus smelting and production bonuses of 1.5 and 1.0 cents, respectively. In the second half the tonnage bonus became 3 cents, other elements remaining the same. This bonus was payable on a graduated scale for excess over a 16,632 long-ton payable tin content of the year's shipments. Provision was made for shipments other than those of the Patino group to United Kingdom, to Chile, and for the use of the Oruro smelter.[1]

The agreement with Belgian Congo also expired on June 30. The

[1] The text of the agreement was published in American Metal Market, vol. 53, No. 180, Sept. 18, 1946, p.4.

producers had long been dissatisfied with their price, said to have been 55 cents, f. a. s. West African port, and were reportedly unwilling to make a new contract except at above 70 cents.

GOVERNMENT CONTROLS

Dwindling stocks and inadequate new supply necessitated retention of various controls over tin consumption in 1946. They were made effective principally through CPA Conservation Orders M–43, which limited distribution of tin, and M–81, containers. CPA Iron and Steel Production Order M–21 further provided means for directing the use of tin-mill products to certain purposes. Early in the year, during the steel mill work stoppages, Direction 9 under this order confined use of tin plate to specified uses, principally packing of seasonal and perishable foods. There were subsequent modifications and in December the restrictions were lifted. As a part of the overall plan to remove Federal controls over the flow of industrial raw materials, several amendments to M–43 and M–81 permitted wider use of tin. In general, they raised consumer quotas and permitted the use (or a greater percentage) of tin, in various products; regarding containers, they removed quota limitations and allowed the use of tin plate for a wide variety of food and nonfood packs heretofore prohibited. The tin weight for various packs, however, remained under control. At the year end the CPA, with general industry approval, reported that, in view of the continued scarcity, controls would be continued through March 31, 1947, when authority therefor under the second War Powers Act expired.

After 5 years of restrictions that held use of virgin tin in the neighborhood of 54,000 long tons despite the abnormal use in bronze and brass, it would appear that a much higher consumption need not arise when limitations no longer exist. Among the notable savings was that in solder. Automobile makers were large users; one large manufacturer estimated it to require 5 pounds of tin per car in 1940, with about 2 pounds in 1945, and there was a suggestion that return would not be made to earlier practice. The major saving was, however, in the development and use of electrolytic tin plate. This was reliably estimated to have exceeded 60,000 tons in the 5 years 1941–45. In 1946 the trend toward electrolytic plate was not accentuated. It comprised nearly one-third the total tin-plate production as in 1945. However, the output of electrolytic plate rose 3 percent, whereas that of hot-dipped was less than 1 percent higher than in 1945. In 1946 the average weight of tin per short ton of tin plate was 11.9 pounds for electrolytic, with 27.1 pounds for hot-dipped plate. Corresponding averages for 1945 were 11.9 and 27.2 pounds.

DOMESTIC TIN INVESTIGATIONS

Small-scale field investigations of tin occurrences were carried out in 1946. The Bureau of Mines continued exploration in the Cape York district, Alaska, and planned further work, in 1947. Several

publications [2] reviewing wartime strategic mineral surveys relating to tin have been issued. A general review [3] of Alaska's mineral potential by Bain gives a short summary of recent work.

DOMESTIC PRODUCTION

MINE OUTPUT

For the second successive year no production of domestic tin ore or concentrates was reported to the Bureau of Mines. Although investigations in known tin areas have revealed small deposits, none has shown evidence of being able to sustain a sizable commercial operation, even at a very high price for tin.

Mine production of tin (content) in the United States, 1942–46, by States, in long tons

Year	Alaska	South Dakota	Other States [1]	Total	
				Long tons	Value
1942	2.8	1.4	2.1	6.3	$7,300
1943	.1	.6	5.2	5.9	6,800
1944		[2]	[2]	5.4	6,200
1945					
1946					

[1] 1942: Alabama, California, Nevada, and New Mexico; 1943: California, Nevada, and New Mexico; 1944: California, New Mexico, North Carolina, and South Dakota.
[2] Included in total.

SMELTER OUTPUT

In 1946 domestic tin smelters made a new high, with an output exceeding 43,500 long tons of metallic tin. This record was attributable to the 7 percent greater output of the Government-owned Longhorn smelter compared with that of the preceding year. Beginning in October 1945 with a record monthly outturn of 3,558 long tons, production increased each month through May 1946, when a new peak of 3,904 tons was established. Thereafter, largely, because of a dearth of concentrates, output fell and averaged 3,151 tons a month in the last quarter, and as the smelter's stocks were reduced to a working level production probably will not rise unless receipts increase.

The Longhorn smelter—which probably would rank as the world's largest if high-grade alluvial concentrates were procurable—nevertheless has produced more tin than any other since it began operation in April 1942. In nearly 5 years to the end of 1946, it had turned out 151,101 long tons of metal, with by far the greater part as Grade A. More than three-quarters of the ore supply was in the form of highly impure and low-grade Bolivian concentrates with a tin content range

[2] Heide, H. E., Investigations of the Lost River Tin Deposit, Seward Peninsula, Alaska: Bureau of Mines Rept. of Investigations 3902, 1946, 57 pp.
Heide, Harold E., Wright, Wilford S., and Sanford, Robert S., Exploration of Cape Mountain Lode-Tin Deposits, Seward Peninsula, Alaska: Bureau of Mines Rept. of Investigations 3978, 1947, 16 pp.
Volin, M. E., Russel, P. L., Price, F. L. C., and Mullen, D. H., Catron and Sierra Counties Tin Deposits, N. Mex.: Bureau of Mines Rept. of Investigations 4068, 1947, 60 pp.
[3] Bain, H. Foster, Alaska's Minerals as a Basis for Industry: Bureau of Mines Inf. Circ. 7379, 1946, 88 pp.

generally of 18 to 50 percent and a 1946 average in the neighborhood of 37 percent. Early in the year operating and miscellaneous costs were estimated to have been about 7.0 cents a pound of tin produced. Ore costs were about 65 cents, making a total of approximately 72 cents. With the selling price at 52 cents until November, sales were subsidized to the extent of 20 cents a pound or a total of about $17,000,000 for the year. During the year experiments on recovery of acid and metals from plant waste were carried out, and the construction of an ingot-casting machine was undertaken.

In addition to the Government smelter only the Vulcan Detinning Co. plant was active in 1946. This company has been experimenting with processes for the recovery of tin from complex low-grade ores.

SECONDARY TIN

Notwithstanding the strong demand and high prices that prevailed, the quantities of tin-bearing scrap—principally copper- and lead-base materials—treated in 1946 at secondary plants fell sharply and resulted in a drop of over 21 percent in total tin recovery compared with 1945. The decline in recovery at detinning plants was virtually of the same magnitude (21 percent) and was almost fully attributable to the 75-percent decrease in old cans treated, while the quantity of new clippings treated was off about 3 percent but only 1 percent in tin recovered. Although the CPA conservation order (M–325, effective June 16, 1943) that had directed tin-plate scrap and old cans to detinners was not revoked until November 26, 1946, the never effective salvage campaign deteriorated with great rapidity after mid-1945, and a year later the preparation of old cans by housewives had practically ceased.

Secondary tin recovered in the United States, 1925–29 (average) and 1942–46, in long tons

Year	Tin recovered at detinning plants			Tin recovered from all sources			
	As metal	In chemicals	Total	As metal	In alloys and chemicals	Total	
						Long tons	Value
1925–29 (average)	900	2,000	2,900	7,500	23,100	30,600	$38,034,120
1942	4,700	200	4,900	5,200	28,700	33,900	39,434,720
1943	3,900	200	4,100	4,700	29,100	33,800	39,332,800
1944	3,350	310	3,660	3,800	25,300	29,100	33,892,560
1945	3,150	400	3,550	3,300	28,100	31,400	36,538,320
1946	2,480	330	2,810	2,600	22,100	24,700	30,205,663

Nearly all the secondary tin was recovered at privately owned plants. The Government-owned plant at Birmingham, Ala., ceased operation in April 1946 and, offered for sale by the War Assets Administration in November, was sold for other than tin-recovery purposes. Its capacity was 20,000 tons of scrap annually. The Secondary Metals—Nonferrous chapter in this volume contains details on secondary tin recovery.

CONSUMPTION

APPARENT CONSUMPTION

Apparent consumption of tin in 1946 increased 21 percent over that in the preceding year. This figure is derived by adding net imports to domestic smelter production. Since changes in consumer, dealer, and Government stocks are not taken into account, the calculated figure may depart widely from the actual. When, as in the preceding 4 years, the deficit in supply is made up from accumulations, the apparent use understates the true value. The accompanying table gives the data for 1939–46. Comparable figures for 1910–38 were published in Minerals Yearbook, 1939, page 680.

Apparent consumption of tin, 1939–46, in long tons [1]

1939	67,997
1940	123,537
1941	141,618
1942	42,512
1943	[2] 31,638
1944	43,379
1945	[2] 48,086
1946	58,144

[1] Exports of domestic tin are not included in 1939–41. They are included in the figures for 1942–46 and are 244, 398, 405, 708, and 859, respectively.
[2] Revised figure.

CONSUMPTION BY USES

Despite some liberalization in permitted uses in 1946, the total consumption of tin was 3 percent below that of 1945 largely because of strikes in consuming or related industries. The consumption of primary metal did not reach the prewar (1935–39) average by about 8,000 long tons or 12 percent and was approximately 60 percent of the quantity estimated early in 1946 if there had been an unlimited availability. Such a consumption figure now appears unduly high. Tin savings based on the retention of some wartime economies render direct comparisons with prewar periods misleading. They are resorted to here solely for reference. The accompanying tables derived from reports made to the Bureau of Mines show actual consumption of primary and secondary tin, both where it entered process and left as finished products.

Tin plate (and terneplate) was the predominant user of primary tin, taking 48 percent of the new metal or about 6,000 tons (19 percent) less than in 1935–39, while, owing to the growing adoption of electrolytic plate, tin plate output was 22 percent higher. Solder, in second place, took 23 percent more than in 1945 and nearly 25 percent of the new tin used, owing to relaxation in tin limitations. Babbitt, which in the prewar period accounted for a little more than 6 percent of virgin tin consumption and held third place, remained in fourth position and took about 8 percent of the virgin tin. Third in rank was bronze (and brass), for which 34 percent less new tin was used in 1946 than in 1945.

In respect to total tin used, the four largest product groups accounted for more than 90 percent compared with 80 percent in 1935–39. Tin plate recovered first place, with 32 percent, followed by bronze and brass 28 percent, solder 21 percent, and babbitt 9 percent.

Consumption of primary and secondary tin in the United States, 1942–46, in long tons

	1942	1943	1944	1945	1946
Stocks on hand Jan. 1 [1]	67,421	43,853	34,735	27,391	25,789
Net receipts during year:					
Primary	33,126	40,548	55,323	54,663	56,603
Secondary	5,096	4,462	2,536	2,623	2,236
Terne	405	188	228	312	257
Scrap	26,941	29,903	28,883	28,498	26,057
Total receipts	65,568	75,101	86,970	86,096	85,153
Available	132,989	118,954	121,705	113,487	110,942
Stocks on hand Dec. 31 [1]	43,853	34,735	27,391	25,789	27,100
Total processed during year	89,136	84,219	94,314	87,698	83,842
Intercompany transactions in scrap	2,547	2,889	3,205	3,239	2,091
Total consumed in manufacturing	86,589	81,330	91,109	84,459	81,751
Plant losses	902	1,000	1,140	876	808
Tin content of manufactured products	85,687	80,330	89,969	83,583	80,943
Primary	56,288	46,253	59,156	55,642	54,627
Secondary	29,399	34,077	30,813	27,941	26,316

[1] Stocks shown exclude tin in transit or in other warehouses on Jan. 1, as follows: 1942, 2,700 tons; 1943, 78 tons; 1944, 316 tons; 1945, 1,941 tons; 1946, 1,600 tons, and 1947, 1,000 tons.

Consumption of tin in the United States, 1944–46, by finished products (tin content), in long tons

Product	1944			1945			1946		
	Primary	Secondary	Total	Primary	Secondary	Total	Primary	Secondary	Total
Tin plate	24,968		24,968	26,080		26,080	26,127		26,127
Terneplate	510	230	740	493	248	741	208	238	446
Solder	8,786	4,841	13,627	10,930	3,399	14,329	13,443	3,673	17,116
Babbitt	5,790	2,996	8,786	4,144	3,684	7,828	4,125	2,874	6,999
Bronze and brass	13,768	19,327	33,095	9,093	17,972	27,065	5,963	16,594	22,557
Collapsible tubes	283	242	525	515	44	559	701	88	789
Tinning	2,771	370	3,141	2,390	202	2,592	1,903	205	2,108
Foil	226	92	318	181	64	245	174	46	220
Pipe and tubing	230	32	262	204	89	293	273	64	337
Type metal	49	1,302	1,351	10	1,281	1,291	123	1,865	1,988
Bar tin	1,092	167	1,259	963	131	1,094	891	78	969
Miscellaneous alloys	417	707	1,124	378	228	606	373	168	541
White metal	19	86	105	65	151	216	68	77	145
Chemicals	34	259	293	196	448	644	255	346	601
Miscellaneous	213	162	375						
	59,156	30,813	89,969	55,642	27,941	83,583	54,627	26,316	80,943

STOCKS

The planned deterioration in the stock position in the United States, as in the world at large, was much in evidence in 1946. Actually the drop was a few thousand tons less than anticipated because of the steel and coal strikes. At the end of 1946, total stocks of tin and tin in ore were 71,734 long tons or 14 percent less than at the end of 1945. The total excludes 9,817 tons of Japanese tin sent to the United States by the Supreme Commander for the Allied Powers,

subject to international allocation by the Combined Tin Committee. The CTC, at its October 23, 1946, meeting, made 4,990 tons available. There being no other takers, it was acquired by the United States in February 1947. In addition, 12,204 tons were in process in scrap and as secondary tin. Aside from 12,140 tons of pig tin held by the Navy Department and the Bureau of Federal Supply (formerly the Procurement Division) of the Treasury Department, the Government held 18,932 tons of metal and 24,642 tons of tin in concentrates, down respectively 11 and 24 percent from 1945.

Usable Government stocks were something over 7 months' supply at the 1946 use rate; but much was locked up in in-process materials, and new supply available for distribution became essentially equivalent to receipts of foreign metal plus output of domestic smelters.

Stocks of virgin pig tin in the United States, Dec. 31, 1942–46, in long tons [1]

	1942	1943	1944	1945	1946
At consumers' plants	31,064	22,861	17,337	14,102	14,532
At other warehouses and in transit	78	316	1,941	1,600	1,000
Held by jobbers	84	50	47	69	124
Total consumers' stocks	31,226	23,227	19,325	15,771	15,656
Afloat to United States (estimated)	900	1,650	1,800		1,570
Total stocks [1]	32,126	24,877	21,125	15,771	17,226

[1] Excludes Government purchases delivered for stock piling or at Texas City smelter. Also excludes tin in process and secondary pig tin.

As customary for more than a decade, the Bureau of Mines canvassed tin users to determine consumption and stocks of tin. According to the replies, consumers had 14,532 tons of virgin tin at the year-end, of which 7,286 tons were held by tin-plate manufacturers; in addition, 439 tons of secondary pig tin were on hand. At the end of the year 1,000 tons of primary tin were in transit and in warehouses.

PRICES

In the United States in 1946 the price of tin until November 12 was held at the ceiling of 52 cents a pound (Grade A) established in 1942 by the Government. The President announced November 10 (Sunday) the lifting of most price controls. On November 12 the principal detinners named a price of 70 cents a pound for Grade A tin; and the following day the predominant supplier, the Office of Metals Reserve, directed the Tin Sales Corporation, its distributor, to price all uncompleted November and new November allocations at the same figure. At the end of the month the price for December deliveries was fixed at 70 cents for Grade A, with the usual differentials for other grades. The average for the year, according to the American Metal Market, was 54.58 cents. The November change brought domestic prices close to those established for the United Kingdom 1½ months earlier.

Prices, by grades and brands, beginning November 12 were as follows:

Grade A. 99.80% or higher, meeting specifications set forth in M. P. R. No. 17	70.00c
Following brands of pig tin will be considered as qualifying as Grade A: Longhorn 3-Star, Chempur, Pyrmont, Straits Trading, O. T. Lempriere & Co., E. S. Coy (Penang), Billiton, Mellanear (Guar. 99.9%), Hawthorne Refined, Banka, Union Min. du H. Katanga, M and T No. 1, M and T Electrolytic Refined, Vulcan American Refined, Vulcan Electrolytic , Pass No. 1.	
Grade B. 99.80% or higher, not meeting specifications for Grade A, providing arsenic content does not exceed 0.05%	69.87½c
Grade C. 99.65% to 99.79% and 99.80% or higher, not meeting specifications for Grade A or Grade B	69.62½c.
Grade D. 99.50% to 99.64% (includes Longhorn 2-Star)	69.50c.
Grade E. 99.00% to 99.49% (includes Longhorn 1-Star)	69.12½c
Grade F. Below 99% pure (for tin content) (includes Longhorn No-Star)	69.00c.

Tin prices, 1925–29 (average) and 1942–46

	1925–29 (average)	1942	1943	1944	1945	1946
Average prices:						
New York: [1]						
Straits tin, cents per pound	56.64	[2] 52.00	[2] 52.00	[2] 52.00	[2] 52.00	[3] 54.58
99.75-percent tin (English refined), cents per pound	[4]	[5] 51.625	[5] 51.625	[5] 51.625	[5] 51.625	[5] 54.208
99-percent tin, do	55.50	[6] 51.125	[6] 51.125	[6] 51.125	[6] 51.125	[6] 53.708
London: [7]						
Standard tin, £ per long ton	254.6	[8] 275.0	[8] 275.0	[8] 300.0	[8] 300.0	[9] 321.2
Do, cents [10] per pound	55.17	49.54	49.54	54.04	[11] 54.04	57.83
Premium allowed over standard:						
Straits, £ per long ton	5.1	[4]	[4]	[4]	[4]	[4]
Banka, do	6.9	[4]	[4]	[4]	[4]	[4]
English, do	—.7	[4]	[4]	[4]	[4]	[4]
Price indexes (1925–29 average=100):						
Straits tin (New York)	100	92	92	92	92	96
Copper (New York)	100	80	80	80	80	93
Lead (New York)	100	87	87	87	87	109
Nonferrous metals [12]	100	87	87	87	87	100
All commodities [12]	100	101	105	106	108	121

[1] American Metal Market.
[2] Maximum for Grade A, 99.8 percent or higher (includes Straits).
[3] Maximum price for Grade A, 52 cents until Nov. 10, 1946; 70 cents thereafter.
[4] Data not available.
[5] Maximum for Grade B, 99.75–99.79 percent, and Grade C, Cornish refined.
[6] Maximum for Grade D, 99.0–99.74 percent.
[7] Metal Bulletin, London, as compiled by International Tin Research and Development Council.
[8] British Government maximum price.
[9] British Government maximum. To Sept. 26, £300, thereafter £380 10s.
[10] Conversion of British quotations into American money based upon average rates of exchange recorded by Federal Reserve Board.
[11] Official rate; free rate, 53.98.
[12] Based upon price indexes of U. S. Department of Labor.

It long had been recognized that the domestic selling price was much below cost. The Office of Metals Reserve had been authorized at the end of 1945 to price tin for export without reference to price ceilings, but up to March 1 the export price was held at the internal level. It was then raised 6 cents to 58 cents, was advanced on June 1 to 61 cents, on September 21 to 64 cents, on November 1 to 69½ cents, and finally on November 13 to 70 cents—the new domestic price. Although tin exports have been inconsequential, the prices set seemingly reflected an attempted adjustment to foreign levels.

In the United Kingdom, the domestic price was held at £300 a long ton delivered buyers' works until September 26, when it was

raised to £380 10s. (99.0–99.75 percent grade) or 68⅜ cents. At the beginning of the year the export price was £375. On April 1 it was cut to £357 and then on September 26 was raised, delivered port, to the internal price. In Canada tin sold at 57¾ cents until after the dollar revaluation of July, when it became 63½ cents a pound.

At least since the closing of the London Metal Market in December 1941 there has been no generally accepted world price. British and American controlled sales prices since that time have run an approximately parallel course, but elsewhere there have been wide departures therefrom, as noted in earlier chapters of this series. The situation became even more complex when differential export prices were established. The gap between buying and selling prices became exaggerated as sellers refused to make new contracts at old prices. Not until autumn was there an approach to an approximate average and to one that reflected the greatly enhanced cost of production. For the last half year Nigerian producers received £357 10s. f. a. s. port; and Malayan, £370 at Penang-Singapore smelters with export sales at £372. The Bolivian price was raised to about £375 corresponding with the American agreement. At the end of the year the supported Australian price was £A383 or about 55¼ cents a pound. Small sales of "free" tin were said to have brought $1.00 a pound or more in South America, £680 in Hong Kong, and as much as £750 for Portuguese tin.

FOREIGN TRADE[4]

There has been no notable change in the foreign trade pattern since 1942, when imports of concentrates exceeded those of metal. Receipts of foreign tin in 1946 were 83 percent higher than in 1945 and the greatest in the past 4 years. The imports from Japan were a part of the tin stocks seized after the occupation and sent to the United States for grading and analysis. The first lots analyzed about 99.88 percent tin. Shipments from Malaya and Netherlands East Indies may have been in part tin found there after the Japanese evacuation. The tin content of concentrates imported was the highest recorded and was 14 percent more than in 1945. In terms of tin content, Bolivia with 28,520 tons (25,936 in 1945) furnished three-quarters of the material.

Foreign trade of the United States in tin and tin concentrates, 1942–46

Year	Imports				Exports			
	Bars, blocks, pigs, grain, or granulated		Concentrates (tin content)		Ingots, pigs, bars, etc.			
					Domestic		Foreign	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
1942	26,753	$29,311,113	28,933	$21,422,896	244	$290,804	165	$229,512
1943	11,919	13,081,756	21,857	24,804,842	398	464,053	1,372	1,567,043
1944	13,338	15,049,200	35,548	32,346,412	405	488,508	438	532,861
1945	8,493	9,213,425	33,479	32,711,772	708	890,661	174	223,623
1946	15,520	18,507,043	38,070	26,968,713	859	1,153,936	22	31,939

[4] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Belgian Congo supplied 7,214 tons (7,401 in 1945) and the Netherlands East Indies 2,206 tons—the first receipts since 1942. Other sources were French Africa 58 tons (129 in 1945), Portugal 38, United Kingdom 27, Brazil 7, and Mexico none in 1946 (13 in 1945).

Tin [1] imported for consumption in the United States, 1944–46, by countries

Country	1944		1945		1946	
	Long tons	Value	Long tons	Value	Long tons	Value
Belgian Congo	10,000	$11,199,813	6,494	$6,853,883	627	$730,238
British Malaya	(2)	110			2,139	2,492,099
Canada	(2)	13	53	50,000		
China	3,338	3,849,251	1,946	2,309,542	984	1,210,129
Japan					1,969	2,290,890
Mexico					24	27,215
Netherlands Indies					5,409	6,402,249
Portugal					9	10,517
Siam					87	100,906
United Kingdom	(2)	13			4,272	5,242,800
	13,338	15,049,200	8,493	9,213,425	15,520	18,507,043

[1] Bars, blocks, pigs, grain, or granulated.
[2] Less than 1 ton.

The outward movement of tin plate, terneplate, and taggers tin dropped 24 percent from the 1945 level, in part owing to the strike-curtailed output in the United States and an increase of about 85,000 tons in British exports accompanied by a strong domestic demand for containers. In 1945 exports comprised about one-sixth of the tin-plate shipments, whereas they were about one-eighth in 1946. Latin America took, as in 1945, about 30 percent of the total and Canada about 16 percent. The greatest declines, amounting to about 70 percent of the total drop, were in shipments to countries in the British Commonwealth, notably to Australia and the Union of South Africa. A decline of about 32,000 tons in sales to Russia and 6,000 tons to France was not quite balanced by increased exports to other European countries.

Foreign trade in tin plate, taggers tin, and terneplate in various forms, 1942–46, in long tons

Year	Tin-plate scrap		Tin-plate circles, strips, cobbles, etc. (exports)	Waste-waste tin plate (exports)	Terne-plate clippings and scrap (exports)	Tin plate, taggers tin, and terneplate	
	Imports	Exports				Imports	Exports
1942	24,082		1,333	3,230	76	134	593,776
1943	19,591	27	1,607	50	56	101	396,550
1944	17,323	112	1,294	3,103	161	112	436,632
1945	18,072	433	1,684	12,215	378	144	471,149
1946	24,530	141	4,030	6,690	590	298	355,794

Tin plate, terneplate (including long ternes), and taggers tin exported from the United States, 1945–46, by principal countries

Country	1945		1946	
	Long tons	Value	Long tons	Value
Algeria	763	$90,847	1,430	$177,754
Anglo-Egyptian Sudan	1,438	143,557	1	98
Argentina	29,392	3,734,548	25,097	3,312,461
Australia	98,623	11,887,721	48,215	6,096,902
Belgium and Luxembourg	5,849	684,445	15,452	1,943,753
Brazil	50,344	5,723,732	44,447	5,444,229
British East Africa	2,135	211,593		
Canada	60,445	6,636,345	57,808	6,514,646
Ceylon	359	51,700		
Chile	6,231	744,787	4,542	585,231
China			3,127	374,605
Colombia	2,048	262,544	1,693	240,662
Cuba	11,307	1,433,448	14,817	1,858,748
Czechoslovakia			1,118	122,818
Denmark			3,209	408,968
Egypt	1,984	184,445	994	118,496
France	18,839	2,347,500	12,469	1,558,031
Greece	45	5,687	1,507	171,969
India	4,708	574,798	34	4,067
Iran	7,407	726,057		
Italy	41	3,979	8,681	1,003,576
Madagascar	827	93,000	537	68,802
Mauritius	136	17,344		
Mexico	13,619	1,628,460	8,744	1,142,338
Morocco, French	3,860	459,413	5,148	662,653
Netherlands	14,133	1,708,184	24,228	2,976,894
New Zealand	9,177	1,063,777	9,938	1,227,904
Norway			7,137	854,704
Palestine and Trans-Jordan	469	46,290	406	55,101
Paraguay	1,815	212,436	3,559	439,304
Peru	2,594	298,332	1,709	226,555
Philippines, Republic of	95	15,738	2,219	307,443
Portugal	15,350	1,843,732	6,118	803,468
Southern Rhodesia	752	86,310	57	7,138
Spain	1,715	218,620	247	31,304
Sweden	2,937	380,224	8,607	1,040,780
Switzerland	545	67,759	3,962	362,347
Syria	1,278	125,668	283	33,532
Turkey	5,600	597,404	2,231	247,999
Union of South Africa	36,688	4,168,597	12,174	1,427,238
U. S. S. R.	35,568	4,311,552	3,768	457,148
United Kingdom	714	86,924		
Uruguay	14,679	1,812,313	3,186	396,005
Venezuela	2,936	379,648	1,933	258,837
Yugoslavia	25	3,080	1,830	202,022
Other countries	3,679	440,457	3,132	402,291
Total	471,149	55,512,995	355,794	43,568,821

Foreign trade in miscellaneous tin, tin manufactures, and tin compounds, 1942–46

Year	Miscellaneous tin and manufacture				Tin compounds	
	Imports			Exports—Tin scrap and other tin bearing material, except tinplate scrap (value)	Imports (pounds)	Exports (pounds)
	Tin foil, tin powder, flitters, metallics, and tin manufactures n. s. p. f. (value)	Dross, skimmings, residues, and tin alloys, n. s. p. f.				
		Pounds	Value			
1942	$949	505,346	$63,978	$301,133		117,191
1943	4,140	294,884	12,379	202,423		25,042
1944	3,682	113,556	11,640	654,498		25,992
1945	1,403	127,680	29	453,816	25	35,107
1946	5,298	1,100	596	482,733	308	(1)

[1] Not separately classified.

WORLD REVIEW

INTERNATIONAL CONTROLS

The International Tin Control scheme remained formally in force to December 31, 1946, though practically it had not functioned after the British capitulation at Singapore in early 1942. A meeting of the International Tin Committee was held in London in March 1946 to discuss recommendations to be made to the participating Governments as to its future. The recommendations were not made public, but it was believed that continuation of the scheme was supported. At any rate, numerous influential producers strongly favored an extension to prevent the return of disordered industry conditions when an excess in supply should arise, which appeared probable by 1949 or (as later estimated) by 1950. Strong consumer opposition, principally on the part of the United States, brought about the support of the British Government to place the problem of tin production and distribution in the hands of a Study Group separate and distinct from the ITC, that later could be a unit of or related to the International Trade Organization proposed by the Department of State.

The first step toward that end was made by the United Kingdom Government after consultation with the Governments of the United States, Belgium, Bolivia, and the Netherlands in September 1946, when invitations were sent to the major producing and consuming countries—Belgium, Bolivia, China, France, Netherlands, Siam, United States, and the U. S. S. R.—which were asked to send delegates to an international conference to be held in London in October. The meeting was to consider the prospective tin position and whether any continuous intergovernmental study of that position is required. Delegates from all the invited countries except the U. S. S. R. attended the meeting. The conference agreed that world production in 1946 would be 94,400 tons, against consumption of 136,600 tons. In 1947 output was expected to reach 141,600 tons, with unrestricted use then reaching 190,000 tons and remaining through 1949 at that quantity, in which year production would have become 218,500 tons. The conference agreed that there was need for a continuing review of the world situation and consequently would recommend that an international tin study group be established as soon as possible. It was further agreed to recommend that the Combined Tin Committee continue to make allocations of available tin during the period of short supply and, moreover, that interested countries discuss means for continuation of the Tin Research Institute. The United Kingdom was to obtain, by January 1, 1947, from the governments invited to this conference, their decisions in respect to the establishment of the study group and to arrange for an early meeting. Early in 1947 acceptances were received and an organizational meeting was called for April 1947 at Brussels.

There was considerable dissatisfaction with the conference results. The final dissolution of the ITC was not touched upon, nor were matters of price, free markets, and the smelter situation discussed. The principal objection was that the study group would lack all authority, serving purely in an advisory capacity to the several interested governments.

WORLD MINE PRODUCTION

The receipt of official reports from many tin-producing countries has made possible further revisions in the accompanying table. Actual production figures for British Malaya during the Japanese occupation are not available, but the gross weights of production given by the Chief Inspector of Mines have been used as the basis for estimates.

Mine production in 1946 was approximately 3 percent greater than in 1945 and fell substantially below the expected figure, largely because of a decline in Bolivian exports and the slow recovery in southeast Asia, notably in Malaya. Supply exceeding normal demand is now not anticipated at earliest until 1949.

World mine production of tin (content of ore), 1925–29 (average) and 1939–46 by countries, in long tons

[Compiled by B. B. Mitchell]

Country	1925–29 (average)	1939	1940	1941	1942	1943	1944	1945	1946
Restricted production:									
Belgian Congo	967	7,140	12,075	15,751	15,754	17,007	16,858	17,070	14,095
Bolivia (exports)	37,169	27,211	37,940	42,199	38,293	40,312	38,720	42,357	37,717
British Malaya	56,837	46,827	84,082	[1] 78,000	15,748	26,000	9,309	3,152	8,432
Indochina, French	691	1,467	1,472	1,295	1,029	653	358	[1] 100	[2]
Netherlands Indies	33,266	27,755	43,193	[1] 51,000	9,812	17,457	6,719	843	6,535
Nigeria	8,319	9,567	12,177	12,229	12,574	12,835	12,512	11,224	10,333
Siam	8,204	[3] 17,325	17,447	[1] 15,000	7,843	5,839	3,194	1,275	[1] 500
Total signatory countries	145,453	137,292	208,386	215,500	101,053	120,103	87,670	76,200	78,000
Unrestricted production:									
Argentina	32	1,655	1,481	921	998	1,070	1,004	[1] 700	[1] 600
Australia	2,830	3,067	3,501	3,494	2,931	2,635	2,547	2,282	2,127
Burma	2,228	8,536	[1] 5,500	[1] 5,000	[2]	[1] 1,000	[1] 500	[1] 200	[2]
Cameroun, French		243	218	220	233	194	161	112	111
Canada				29	553	347	231	379	390
China	[3] 7,085	[4] 15,000	[4] 11,500	[4] 12,000	[1] 7,000	[1] 7,500	[1] 3,000	[1] 1,500	[1] 2,500
Germany [5]	98	285	293	303	547	[1] 980	[1] 980	[2]	[2]
Italy		256	309	230	200	[2]	[2]	[1] 20	[1] 115
Japan	590	1,473	1,760	2,177	1,894	1,107	374	[2]	[2]
Mexico	2	289	345	212	365	426	317	174	[1] 300
Morocco, French	4	31	20	26	4	11	9	11	12
Peru		47	72	47	75	79	73	54	31
Portugal	625	1,486	1,721	2,330	2,670	3,460	[1] 1,800	[1] 600	[1] 1,000
Portuguese East Africa	5	7	6	4	10	6	8	2	2
Rhodesia:									
Northern			16	10	2	3	6	18	6
Southern	15	451	450	231	162	178	123	125	100
South-West Africa	149	156	137	120	110	158	123	185	177
Spain	145	106	100	103	239	222	483	950	[1] 1,300
Swaziland	138	114	103	131	113	109	77	53	37
Tanganyika (exports)	22	224	258	247	193	159	124	137	132
Uganda (exports)	98	354	334	302	283	296	288	215	201
Union of South Africa	1,174	482	518	463	508	526	506	493	487
United Kingdom	2,658	1,633	1,620	1,509	1,363	1,359	1,289	993	793
United States	24	34	49	56	6	6	5		
Total nonsignatory countries	17,922	36,000	30,300	30,200	20,500	21,800	14,000	9,300	11,000
Grand total [1]	163,000	173,000	239,000	246,000	122,000	142,000	102,000	86,000	89,000

[1] Estimated by authors of chapter.
[2] Data not available; estimate by the author included in total.
[3] Exports.
[4] Based on data published by Chinese Government agencies.
[5] Data include Sudetenland.

WORLD SMELTER PRODUCTION

For the third year the United States was first in the smelting of tin ores, followed by the United Kingdom. Smelters in Malaya were in operation but were limited in output because of the shortage of ore supplies and to a minor degree lack of fuel. Native Siamese smelters were probably inactive, and in Japan one plant worked at part capacity for 3 months. On the Continent, Belgian and Dutch plants resumed on a small scale, whereas the principal British reduction works was reported to be near normal capacity. The accompanying table gives estimates of smelter output in 1939–46.

World smelter production of tin, 1925–29 (average) and 1939–46, by countries, in long tons

[Compiled by B. B. Mitchell]

Country	1925–29 (average)	1939	1940	1941	1942	1943	1944	1945	1946
Argentina	----------	1,080	881	768	709	552	467	714	[1] 500
Australia	2,952	3,294	3,544	3,656	3,024	2,565	2,442	2,359	[1] 2,000
Belgian Congo	----------	2,711	7,832	11,818	13,963	11,068	[1]10,000	6,713	[1] 2,372
Belgium [1]	720	[2] 3,100	[3]	[3]	[3]	[3]	[3]	----------	[1] 2,000
British Malaya	[4] 88,855	[4] 81,536	[2]126,945	[1]125,000	[1]10,000	[1]15,000	[1] 5,000	[1] 2,500	[1] 7,500
Canada	----------	----------	----------	29	553	347	231	379	390
China	[5] 7,080	14,019	10,517	11,188	7,756	7,091	1,982	[1] 1,000	1,929
Germany [6]	3,444	7,000	3,000	3,000	4,000	5,000	4,000	[3]	[3]
Indochina, French	----------	[3]	[3]	69	337	389	[1] 213	[1] 14	[3]
Italy	----------	146	330	72	228	[1] 110	[3]	6	[1] 30
Japan [7]	606	2,025	1,661	2,620	3,870	2,058	759	121	68
Mexico	[3]	90	116	150	320	395	286	166	263
Netherlands	[8] 1,000	[1] 14,600	2,967	[3]	[3]	[3]	[3]	[3]	[1] 800
Netherlands Indies	14,749	13,941	22,035	[1] 23,000	[1] 8,000	[1]12,000	[1] 3,000	[1] 500	----------
Norway	[3]	283	206	98	48	23	27	80	[3]
Portugal	[9] 2	30	781	1,481	2,381	3,058	373	182	114
Siam (Thailand)	[10] 113	----------	----------	----------	[1] 1,000	[1] 3,500	[1] 2,500	[1] 1,000	[3]
Spain	----------	138	112	86	99	121	515	1,111	[1] 1,150
Union of South Africa	----------	----------	33	143	535	862	1,150	1,033	858
United Kingdom	45,800	37,400	[3]	40,000	30,000	31,026	[1]25,000	[1]28,000	[1] 28,590
United States [11]	----------	----------	1,391	1,839	16,168	21,489	30,884	40,475	43,500
Total (estimate)	165,000	181,000	224,000	225,000	103,000	117,000	89,000	86,000	92,000

[1] Estimated by authors of chapter.
[2] Yearbook of American Bureau of Metal Statistics.
[3] Data not available; estimate by authors of chapter included in total.
[4] Exports plus difference between carry-over (on lighters and warrants) at end and beginning of year.
[5] Exports.
[6] Includes production of some secondary tin.
[7] Preliminary data.
[8] Estimated production in 1929.
[9] Average for 1926–27.
[10] Average for 1926–28.
[11] Including tin content of ores used direct to make alloys.

REVIEW BY COUNTRIES

Bolivia.—Exports of tin in concentrates and ore by Bolivia (37,717 tons) in 1946 declined 11 percent from 1945. The monthly rate of shipments improved during the latter half of 1946, consonant with the more favorable terms of a new retroactive tin ore-buying contract that was finally ratified on September 13, 1946. While terms were being negotiated, no material was tendered agents of the Reconstruction Finance Corporation. Ores continued to be shipped, however, to usual ports of destination. When the year closed, about 4,500 tons of tin in ore belonging to the United States were awaiting ship-

ment in South American ports. (Features of the contract are summarized in the section on Government Tin Operations.) Shortly before this contract expired on December 31, 1946, producers indicated they were going to ask for an increase in price to 76 cents for their product; and until a new contract was completed, producers decided to retain all production after January 1, 1947. There were reports during the latter part of October 1946 that Argentina was interested in acquiring Bolivian tin.

The United States was the destination of about 60 percent of 1946 shipments, and the remainder went to the United Kingdom. A considerable tonnage of low-grade material containing only about 8 percent tin from Compania Minera de Potosi was shipped to the Capper Pass smelter in England during the latter part of the year. The Hochschild group had been authorized to export 1,000 tons unsuited for treatment at the Texas City smelter. Consequently, shipments by the Medianos (independent intermediate-size operators)—13 percent of the total—increased 2 percent, whereas all other groups declined.

During 1946 exports of the Patino group amounting to 44 percent of the total declined 14 percent; those of the Hochschild group (27 percent) were 15 percent lower; those of Aramayo (7 percent) were 3 percent lower; and the small mines (9 percent) decreased 9 percent.

Political disturbances, labor difficulties, and increased operating costs adversely affected tin mining during 1946. Early in the year attempts were made to overthrow the Villarroel government. On July 18 an open revolt took place during which Villarroel and many other persons were killed. The provisional revolutionary government then set up was recognized by the United States on August 12. Cia. Minera Agricola Oploca de Bolivia (Patino group), which had been producing about 1,500 tons of fine tin annually, announced in November its intention to close down because of high costs. The San Jose mine of the Hochschild group was threatened with occupancy by the miners, but high costs presaged its probable early closing. Aramayo workers threatened to strike during February; and there were further disturbances during the latter part of December, when labor strikes occurred at this company's Telamayu and Animas mines. A strike of railroad employees tied up shipments of goods for about 9 days in June.

The Oruro tin smelter, after beginning production on a very small scale on ores above 55-percent grade in July, apparently has been unable to continue operations. A Villarroel decree ordering Patino and Aramayo to supply concentrates (50 tons tin content monthly) to the smelter has been considered null and void. The smelter's first test run resulted in the production of metallic tin of 98.75 percent (Grade F). Production costs were considerably more than had been expected.

British Malaya.—Revival of mining in Malaya was beset with manifold difficulties. There had been much damage to plant and equipment during the Japanese occupation, not only deliberately but by unskilled operation and faulty maintenance. The Japanese had surrendered in September 1945, but little other than surveys of prevailing conditions were carried out until the following spring. About one-third of the labor force had been dissipated, and there was serious

unrest among the remainder because of near-starvation conditions and lack of clothing and shelter—all aggravated by communist incitations. New equipment and replacements were slow to arrive and high in cost. Many Chinese, for example, did not reopen their properties because of the high cost of gravel pumps and because regulations covering rehabilitation loans were slow in the making. This same defect influenced many European operators, who lacked financial reserves to undertake substantial capital expenditures and were also uncertain as to adjustment for war losses and damages. Up to the end of 1946, however, rehabilitation loans of £2¼ to 2½ million had been approved and advances of about 70 percent made. Approved claims for war damage will apply against such loans. Aside from injury to plants was the matter of depletion of reserves. In September the Chief Inspector of Mines, Malaya, reported that the gross weight of Japanese production was 75,264 long tons in 1942–45, respectively, as follows—21,857, 36,161, 12,917, and 4,329 tons. Tin content was not given, but it has been estimated to have been 52,000 and 56,000 tons. Croston [5] estimated metal output to have been "78,797 metric tons of pig tin, mostly from Malayan operations." Imports into Japan from the Straits Settlements for 1942–45 were reported at 25,547 metric tons; and 4,500 long tons of tin and about 6,000 tons of concentrates were found after the British reoccupation.

A further deterrent to production was the matter of price. This had been set at £300 a ton (53⅞ cents a pound). Operators were reluctant to proceed, as their operating costs were much above the prewar level—variously estimated at 50 to 100 percent higher—and operating profits reduced about two-thirds. Further, both Britain and the United States were paying much more for poorer quality Bolivian concentrate. Finally, in September the price for the last half-year was fixed at £370 (66.4 cents a pound). The Tin Ore Buying Agency of the Ministry of Supply—the sole buyer of concentrates—and its Burmese counterpart ceased to fuction at the year end. Producers could then sell directly to any Malayan smelter, but the Ministry of Supply continues to purchase the entire metal output. Distribution is directed by the Combined Tin Committee. None was sent to the United States in 1946.

Coal, almost the entire source of energy, was provided from mines of the Malayan Collieries at Batu-Arang in Selangor. Production was 780,000 tons in 1940. When the British withdrew in 1941 the mine power plant was destroyed and the mines flooded. The Japanese attempted to revive production and mined about 250,000 tons in 1942. By the end of 1945 output had dropped to about 8,000 tons a month, with the mines in very bad condition and the native labor restive and unwilling to work. With the aid of military engineer detachments some repairs were made; and production reached about 25,000 tons in June 1946, then about sufficent to meet requirements. As the year advanced, production fell behind needs because of strikes, so that railroads and mines were rationed late in the year and some dredges shut down in December.

Another unsettling factor was the industrial nationalization pro-

[5] Croston, John J., Siam's Mining Industry Offers New Opportunities: Eng. and Min. Jour., vol. 147, No. 12, December 1946, pp. 60–64.

gram of the Home Government. While this had not been extended to the colonies—and all of Malaya is now essentially one—a White Paper had intimated that similar colonial action would at least be looked upon with favor. Inasmuch as the British coal mines were about to be taken over by the Government, there was some local apprehension that this program would be extended to Malayan coal mines.

Progress in the 1946 rehabilitaion program was disappointing. Reported output was only 786 tons (tin content) in the first quarter, virtually all from hand mining. Four dredges began operation in March; the number increased to 14 in September compared with the 41 expected according to the Inspection Committee report made public in the spring. In September, 24 additional dredges were under repair. At that time 181 mines were in operation (at the beginning of the year there were 45 small Chinese mines) and the month's output was 881 tons. The total for the three quarters was 5,424 tons, of which Chinese mines had furnished 36 percent, European-owned 34 percent, and others the remainder. Dredges that in the prewar period had provided half the tin accounted for only 23 percent of the output with 32 percent from gravel pumping—closely the prewar ratio. During the fourth quarter production increased to 3,008 tons, so that the total for 1946 was 8,432 tons (exports were 9,438 tons) compared with the Inspection Committee prediction of 12,300 tons.

The principal smelters at Penang and Singapore had suffered little damage, although the former had been used by the Japanese. The Penang plant resumed smelting on April 6, 1946, and the Pulau Brani works at Singapore on July 1. The Straits Trading Co., Ltd., plant at Butterworth was badly damaged by the Japanese. Refined-tin production was limited by ore shortage but should rise rapidly in 1947, not only because of increased Malayan mine output but from Burma ores and the British share of Siamese accumulations and new production.

Burma.—Mawchi Mines, Ltd., producer of tin and tungsten, had not completed assessment of damage to its plants and mines by the end of March 1946. During the year orders were placed for essential replacements and supplies. If no unforeseen delays should arise, it was expected that reconstruction would be so far advanced that operation would be resumed in the latter part of 1947. The Tavoy Tin Dredging Corp., Ltd., suffered considerable damage. Its office and records, as well as mine buildings and workshops at three operating sections, were destroyed, and supplies looted. Of six dredges, two were found to be beyond repair; the others were in fair to good order, and repairs to the three better ones were undertaken. The Japanese had worked all the dredges for a short time but had depleted reserves only slightly. All companies have or are submitting claims for compensation of war damage, but it was not expected that the Claims Commission in Burma would undertake their consideration until 1947, and the mining industry was low in the list of claimants. Strained internal political and economic conditions are likely to retard revival of mining.

Japan[6].—The discovery of tin (and tungsten) in 1908 in the ores

[6] Most of this section was abstracted from Tin Metallurgy in Japan, Report 82, Natural Resources Section, General Headquarters Supreme Commander for the Allied Powers, Tokyo, 1947, 34 pp.

of the Akenobe mine, Mitsubishi Mining Co., Ltd., south central Honshu, which had been worked for silver and copper for a millennium, led to the development of a tin mining and smelting industry. This mine has been the source of 60 to 70 percent of Japan's tin. Its peak output was 1,600 metric tons (tin content) in 1937. The ore contains about 0.7 percent tin, and concentrates ranged from about 40 to 55 percent. Most of the remainder of the native supply came from five mines in Kyushu. The Ikuno smelter, for which the Akenobe mine was the main source of ore, was built in 1913 with an annual capacity of about 120 tons; it was increased to about 1,650 tons in 1934 and to about 3,600 tons in the war period, when some high-grade foreign concentrates were used. The crude tin produced assayed about 91 to 97 percent. Depending on the grade and nature of the impurities, crude tin was fire-refined at the smelter or treated in the electrolytic refinery at Osaka constructed in 1920. The Toyo Mining Co., Ltd., reduction works at Oita, Kyushu, was the second largest tin producer. The first section, of about 1,080 metric tons annual capacity, came into operation in 1939. A second unit, of 480 tons annual capacity, began operation in 1941, and a third large one to handle concentrates from Siam and Indochina was constructed in 1941. The first two were supplied principally with tin and tin-lead concentrates from the Mitate mine, the second-largest ore producer in Japan. Until 1939 its ore was shipped to Singapore for treatment. The total output of refined tin in 1939–45 was given at 3,405 metric tons. The Mitsui Mining Co., Ltd., operated two smelters—the Totoro and the Miike plants, at Nobeoka and Omuta in Kyushu. The Totoro smelter was originally owned and built in 1934 by the Nakashima Mining Co., Ltd., and began production of crude tin in 1935. An electrolytic refinery was then added and began production in 1936. Output was very small until 1941, when concentrates from Indochina and Siam were made available. Imports were cut off by 1944 because of shipping losses, and operations ceased in April. The total output in 1938–44 was reported at 691 metric tons fine tin. The Miike plant was a small, temporary unit that operated only from 1942 to 1944 on Siamese and Indochinese concentrates. The total output for the period was only 239 tons.

None of the smelting plants received direct military damage; but some auxiliaries suffered from air raids, and equipment of the principal smelter was in bad condition through lack of care and maintenance. Only the Mitsubishi works was in operation in 1945 and apparently for only a short time. In October 1946 it temporarily resumed operation, using a remaining stock of imported concentrates. Output of refined tin in the last quarter of 1946 was about 70 metric tons. The future rate of operation was estimated at 20 to 40 tons, depending on the supply of coal and concentrates.

Annual consumption in Japan averaged 4,400 metric tons in 1927–31. The militaristic expansion that then set in raised the use to 6,472 tons in 1936. In 1941–45 apparent annual consumption was about 8,000 tons. Requirements for 1947 were estimated to be 3,200 tons. As domestic ores furnished more than 2,000 tons in only 4 years in the past 2 decades, requirements were met by metal imports, except during the war, when concentrates were received from southeast Asia. From 1925 through 1935 pig-tin receipts ranged from

2,970 to 4,252 tons and averaged about 3,750 tons. As preparations for war were made, they increased rapidly, reaching 10,868 tons in 1940. Imports of tin and concentrates from 1941 to 1945 are shown in the accompanying table. According to Croston,[7] the Japanese produced 78,797 metric tons in Malaya; but imports into Japan totaled 25,547 tons for 1942–45, and only about 4,500 long tons of tin had been reported found in Malaya up to the beginning of 1946, leaving about 49,000 metric tons to cover shipments to the other Axis nations, reputedly to Russia, and lost at sea. After the end of the war about 14,000 tons of tin were found in Japan. Nearly 10,000 tons were shipped to the United States for grading and distribution by the Combined Tin Committee, and 4,128 tons remained on hand in Japan as of January 1947.

Japanese imports of tin and tin concentrates, 1939–45, in metric tons

	1939	1940	1941	1942	1943	1944	1945
Metal:							
Straits Settlements	5,480	6,957	1,912	1,829	16,752	3,989	2,977
Netherlands East Indies	702	2,778	3,561	1,486	5,695	5,254	1,346
Other countries	2,282	1,133	7	498	6	150	
Total	[1] 8,464	10,868	5,480	3,813	22,453	9,393	4,323
Concentrates:							
Siam (0.70 tin)			1,968	3,211	240		
Indochina, French (0.68 tin)			600	421	547		
Burma						235	
Other countries			29	34	370	123	
Mixed concentrates (0.57 tin)			124	355	188		

[1] Total given as 7,964 in original source.

Netherlands Indies.—The Dutch returned to Billiton late in October 1945 and to Banka in February 1946. Japanese damage to dredges had not been severe; but much of the electric equipment had been removed, and power plants and transmission lines were wrecked. Revival of mining was slow at first, with only 5 tons output in January 1946. In November it had reached 1,278 tons, and the year's production was 6,535 tons or about 13 percent of the 1941 record but at a much better rate than in Malaya. About 8 dredges out of a prewar 14 were working on Billiton at the year end and 2 on Banka, plus several smaller ones, including suction dredges on overburden removal. Exports were 3,797 tons of pig tin and 4,950 tons in concentrates. The excess over production was derived from stocks, left by the Japanese, consisting of 3,818 tons of metal and 6,618 tons of concentrates (about 70 percent tin). Croston credited the Japanese with production of 31,354 metric tons of tin during the occupation period.

The first of two large dredges ordered in the United States in 1945 was launched October 26, 1946, and the second on January 4, 1947, both in Florida. They have 14-cubic-foot buckets and can dig 100 feet below water line. They are expected to recover, each, about 1,000 tons of tin annually. Orders for six dredges also had been placed in the Netherlands. The first was launched in September and the third in November. Outfitting was to have been completed in February 1947, at which time towing to the Indies would begin.

[7] Work cited in footnote 5 (p. 63).

Early in 1946 it was announced that half the Billiton output—Banka had little during the year—would be sent to the United States and the remainder to the Netherlands for reduction. There the Arnheim smelter had resumed operation and is believed to have produced about 800 tons of tin during the year.

Political conditions became increasingly serious and eventuated in the formation of an Indonesian Republic centered principally in Sumatra and Java, with the eastern islands—the tin group and the Riouws—remaining under Dutch control. Numerous disaffected areas persisted, leaving a final solution of the colonial problem much in doubt.

Nigeria.—Peak production of 12,835 tons in 1943 had declined to 11,224 in 1945 and 10,333 in 1946. Until the end of 1945, the Nigerian producers had contracted with the British Ministry of Supply for sale of concentrates on a prewar cost and profits base to which there had been growing objection. A renewal offer by the Ministry at £300 a ton for tin in concentrates, f. a. s. Nigerian port, was not acceptable to the Nigerian Chamber of Mines. During the war producers claimed that reserves had been notably depleted and plant and equipment had deteriorated through hard and more extended use with inadequate replacement. Now costs had risen, much deferred prospecting had to be undertaken, and the Ministry was paying others much more. Not until September 1946, coincidental with the establishment of new British and Malayan prices, were negotiations concluded. The rates announced were £340 a ton for tin in concentrates, f. a. s. Nigeria port of shipment, retroactive for the first half year and £357 10s. for the second half. Freight, insurance, and smelting charges as in the preceding contract were for the account of the purchaser. It was estimated that these expenses had risen to about £22½ to £25 a ton of tin.

Siam.—With an annual output of about 16,600 long tons in 1939–41, Siam provided 7.6 percent of the world's new supply of tin. Three-quarters of the production was in the hands of "European" operators—almost all British and Australian—with virtually all the remainder in Chinese and Siamese hands. The predominant group's output was mostly derived from dredging, with about 40 dredges in operation at the outbreak of the war. Immediately after the Pearl Harbor attack the Japanese-controlled Siamese Government formed the Thai Minerals & Rubber Co., Ltd., to take over foreign tin enterprises and retained about 90 percent of the capital stock. During the occupation production was 26,032 tons of concentrates containing 18,151 tons of tin. At the end of the war about 16,000 tons of concentrates and 4,000 tons of pig tin remained in Siam. Exports to Japan were 2,691 metric tons of tin in concentrates (metal was not shipped), but reported receipts (see section above on Japan) were about 10 percent less. Some tin was smuggled out of the country both during and after the war.

Formal peace agreements between Siam, Great Britain, and India were signed January 1, 1946, and with Australia on April 3, 1946. Siam expressed willingness to participate in any general international understandings regarding commodity agreements acceptable to the

United Nations. Further, exports of tin, except as recommended by the Combined Tin Committee, would be prohibited until September 1, 1947; and it also agreed to regulate the trade in tin and to stimulate production, while assuming responsibility for all British property rights and interests—including tin stocks—that were valid on December 7, 1941, and to compensate for losses and damage sustained during the war. Protracted discussions between the interested governments followed. They related importantly to procedures for disposal of accumulated tin stocks and of new production. The British program tied the disposal to reparations and would have tended to control the distribution of future output. The United States then entered the discussions and insisted that Siam's sovereignty be maintained and that the United States have free access to Siam's tin. In October the Siamese Government reported that it was prepared to return British and Australian mines to their owners, some of which at about that time were resuming production. On December 7, 1946, agreements were concluded between Siam and Great Britain and Australia. It was agreed that Siam compensate the owners for the operating profits on 15,993 tons of ore (70 percent tin), covering mine stocks as of December 8, 1941, and ore extracted up to the time of the peace treaties, at the price prevailing in 1941—that is, £264 12s. Mine owners further may claim damages for other losses they may have incurred during the war. Siam could then export tin, under supervision of a Tin Commission comprising a representative each from the United Kingdom, Australia, the United States, and Siam and in accordance with the allocations of the Combined Tin Committee. This group, which became the successor of the Combined Raw Materials Board on January 1, 1946, controls distribution of metal only. Siam was therefore free to distribute concentrates to its own advantage and agreed that they should be available equally to the United States and the United Kingdom at the ruling Malayan price, then £370 a ton for metal content. In 1946 the Combined Tin Committee allotted 2,000 tons of tin to the United States, but the first shipment—45 tons—was not received until May 1947 and the first lot of concentrates in June.

At the end of 1946 little was known of conditions at the various mines. Although no scorched-earth program was carried out, plant and equipment had deteriorated considerably. Available spare parts had been used while normal care and maintenance was not exercised, and some mining tracts were heavily depleted. The December agreements, however, contemplated quick compensation to property owners; and with the strong demand, current high prices, and apparent opportunity for new capital investment, it appeared that the Siamese tin industry would revive more rapidly than Malayan.

United Kingdom.—There was a strong upturn in the British tin trade in 1946. Imports of tin were 634 tons and 44,540 tons of concentrates, estimated to contain about 28,400 tons of tin. Exports of pig tin at 20,608 tons were about double those of 1945 and 20 percent above the prewar average. Consumption of primary tin (25,606 tons) was 56 percent higher than in 1945 and 12 percent more than in the 1935–39 period. The total tin used (33,244 tons) was about one-third greater than in the preceding year. The principal increased uses were for tin plate, up 57 percent at 7,331 tons; solder, 14 percent

to 6,646 tons; alloys, 16 percent to 14,055 tons; and collapsible tubes and foil, 342 percent to 2,126 tons. The several increases were at the expense of accumulated Government and consumer stocks that in tin content at the beginning of the year were closely 33,300 tons and at the end 20,400 tons.

Tin-plate ouput (including terneplate) rose sharply from 311,100 tons in 1945 to 439,000 in 1946 and exports (excluding terneplate of about 5,000 tons in each year) moved upward from 27,174 tons to 112,545. The controlled price of coke tin plate for home use was increased in August from 32s. 6d. to 34s. 3d. per base box, f. o. b. markers' works. The export prices were increased several times from 35s. at the beginning of the year to 47s. 6d. f. o. b. port in the last 3 months and averaged 41s. 9.45d. for the year. There was considerable range in the actual prices, which varied with country of destination.

A 5-year plan for the modernization of the British iron and steel industry, estimated to cost £200,000,000 had been approved by the Iron and Steel Federation but had not been agreed to by the Board of Trade up to February 1947. The plan envisaged the expenditure of about £50,000,000 in south Wales, where output is predominantly plate and sheet. A hot-strip and three cold-rolling mills and modern tin-plate mills are to be built. There appeared to be reluctance to provide electrolytic facilities beyond the plant now under construction at Ebbw Vale.

Mine production has declined uninterruptedly from 1,999 tons in 1938 to 793 in 1946. The East Pool and Agar mine that had been worked for more than a century closed in 1945 leaving only the South Crofty and Geevor mines in operation. In the year ended March 31, 1946, the latter crushed 44,943 tons and recovered 552.6 tons of concentrate or 27.54 pounds of black tin a ton. The Ministry of Supply purchased all Cornish tin on a cost-plus basis. An interrogation in the House of Commons brought out that the cost was about £456 (82 cents a pound) a ton in 1945.

Titanium

By HELENA M. MEYER AND R. LOUISE BRYSON

GENERAL SUMMARY

RECORD consumption of ilmenite by manufacturers of titanium pigments featured the titanium industry in 1946 as in 1945. Makers of titanium dioxide operated at a new high rate in 1946 but were unable to supply the unprecedented industrial requirements for their product. The rising use of titanium pigments in recent years has made increasing inroads into markets previously supplied by other white pigments. Titanium dioxide demand was accentuated in 1946, however, as in 1945, by the inability of makers of other white pigments to meet their market demand, chiefly because of crude material shortages. A lower rate of domestic production of ilmenite—8 percent less than in 1945—was due principally to a labor shortage and shorter work week at the world's largest titanium mine, Tahawas, N. Y.; but the gain of 15 percent in imports more than offset the domestic drop, and stocks were augmented by more than 100,000 tons during the year. Inventories of ilmenite on hand at the end of 1946 could fill consumption requirements at the peak rate in 1946 for almost a year.

Labor strikes at coal mines and steel plants impeded the delivery of structural materials, heavy machinery, and equipment for the plant expansion by three domestic titanium dioxide producers. Full effects of the expansion in progress early in 1947 will not be felt before 1948.

Rutile production was at a new record rate in 1946, or 4 percent over 1945. Because of this high rate and the 27-percent drop in consumption, domestic producers could supply domestic requirements for the first time since the mineral has become of industrial significance. Imports dropped 45 percent to the lowest level since 1940. Rutile inventories at the close of 1946 were sufficient for 2 years' consumption at the 1946 rate.

Increased possibilities for use of titanium metal in the light-metal construction field and for other engineering uses, as a result of a process developed by the Bureau of Mines for making cheaper metal, were pointed out in a recent report, discussed briefly under Technology.

The decision of the District Court of the United States for Southern New York that certain factors in the titanium pigments industry were guilty of monopolistic practices, mentioned in the report of this series for 1945, was appealed. The case was argued before the Supreme Court on February 3 and 4, 1947, but a decision had not been rendered at the time this report was written.

Ilmenite prices were reduced from $28–$30 a long ton, f. o. b. Atlantic seaboard, quoted nominally at that level since February 1941, to $19–$20 in December 1946, with the specified average grade

reduced from 60 percent to 57–60 percent. Prices for rutile have been unchanged at 8–10 cents a pound, 94 percent TiO_2, for several years.

DOMESTIC PRODUCTION

Ilmenite output fell 8 percent in 1946 but was second only to the production for 1945. On the other hand, rutile production rose 4 percent to a new high record in 1946. Shipments of ilmenite concentrates in 1946 ranged from 44 to 60 percent TiO_2 and shipments of rutile concentrates from 93 to 94 percent TiO_2.

Production and mine shipments of titanium concentrates from domestic ores in the United States, 1942–46

Year	Ilmenite				Rutile			
	Production (short tons)	Shipments			Production (short tons)	Shipments		
		Gross weight (short tons)	TiO_2 content (short tons)	Value		Gross weight (short tons)	TiO_2 content (short tons)	Value
1942	77,208	93,397	41,328	$1,805,823	2,648	2,649	2,466	$410,956
1943	203,551	211,715	94,283	3,738,970	3,987	3,941	3,639	610,879
1944	278,610	280,791	128,095	7,371,279	6,922	6,770	6,312	1,088,112
1945	308,516	308,518	141,852	7,359,170	7,179	6,837	6,414	869,920
1946	282,447	282,708	130,624	4,878,917	7,453	7,514	7,046	996,989

Florida.—Humphreys Gold Corp., operating under lease from Rutile Mining Co., and its parent company, the Titanium Alloy Manufacturing Co., near Jacksonville, has increased the capacity of its sand-washing plant (for recovery of rutile, ilmenite, and zircon) to 7,500 tons daily. There are 316 spirals in all at this plant.[1] Riz Mineral Co., producer of ilmenite, rutile, and zircon near Vero Beach, ceased operations the latter part of October 1946.

New York.—Production of ilmenite at Tahawus, Essex County, by the National Lead Co., dropped in 1946 compared with 1945 as a result of the labor shortage and reduced work week.

New Jersey.—The Calco Chemical Division, American Cyanamid Co., placed its revamped titanium-pigment facilities in operation at Gloucester City at the end of 1946. The plant was acquired from the Sherwin-Williams Co. in 1945.

North Carolina.—The Yadkin Valley Ilmenite Co., subsidiary of the Glidden Co., produced 17,102 short tons of ilmenite (averaging 52.4 percent TiO_2) at Finley, Caldwell County.

Virginia.—Rutile and ilmenite were produced near Roseland, Nelson County, by the American Rutile Corp., subsidiary of the Metal & Thermit Corp. The Calco Chemical Division of American Cyanamid Co. produced ilmenite at Piney River, Nelson County. A study of the ore body at Piney River indicates that most of the ilmenite is primary and occurs in an igneous dike formation suggesting greater continuity of the ore body.[2]

Wyoming.—The Iron Mountain deposits were examined[3] in 1943 by the Bureau of Mines and a diamond-drilling project was set

[1] Engineering and Mining Journal, vol. 147, No. 10, October 1946, p. 104.
[2] Davidson, D. M., Grout, F. F., and Swartz, G. M., Notes on the Ilmenite Deposit at Piney River, Va.: Econ. Geol., vol. 41, No. 7, November 1946, pp. 738–748.
[3] Frey, Eugene, Exploration of Iron Mountain Titaniferous Magnetite Deposits, Albany County, Wyo.: Bureau of Mines Rept. of Investigations 3968, 1946, 37 pp.

up under the strategic minerals program; drilling operations were completed November 1, 1944. Samples combining all outcrops of the deposit were submitted to Bureau of Mines metallurgical laboratories. The chemical composition of a typical specimen of titaniferous magnetite ore was: TiO_2, 10.5 percent; Fe, 36.05 percent; MgO, 13.4 percent; SiO_2, 16.6 percent.

CONSUMPTION AND USES

Consumption of ilmenite gained 6 percent in 1946, establishing a new high record; but titanium pigments, the chief product made, were in insufficient supply to meet demand, nonetheless. The manufacture of titanium dioxide took 99 percent of the total. All other uses took less ilmenite than in 1945. The use of rutile dropped 27 percent to the smallest total since 1941. Rutile is employed chiefly in welding-rod coatings, which took 84 percent, and alloys and carbide, which took 15 percent.

Consumption of ilmenite and rutile in the United States, 1945–46, by products, in short tons

Product	Ilmenite		Rutile	
	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content
1945				
Pigments (manufactured titanium dioxide)[1]	371,691	183,195		
Welding-rod coatings [1]	115	62	7,813	7,344
Alloys and carbide	8,611	3,976	1,923	1,750
Ceramics			34	30
Miscellaneous [2]	761	347	21	20
Total consumption	381,178	187,580	9,791	9,144
1946				
Pigments (manufactured titanium dioxide)[1]	399,042	200,352		
Welding-rod coatings [1]	105	57	5,990	5,600
Alloys and carbide	4,685	2,025	1,035	966
Ceramics			75	72
Miscellaneous [2]	451	229	34	32
Total consumption	404,283	202,663	7,134	6,670

[1] "Pigments" include all manufactured titanium dioxide, consumption of which in welding-rod coatings was 2,258 tons in 1945 and 938 tons in 1946.
[2] Consists of ilmenite used as a steel flux and rutile used in lamp-electrode coatings and as a steel deoxidizer.

Titanium Pigments.—Production and sales of titanium pigments established new high records again in 1946, but the capacity production rate was inadequate by a substantial margin to fill the peak and still growing demand for the product. As pointed out in the opening statement of this report, the continuing pinch in supplies of raw materials for the manufacture of competitive white pigments (lead for white lead carbonate and white lead sulfate, and zinc for zinc oxide, lithopone, and zinc sulfide) accentuated the stringent supply situation in regard to titanium dioxide. Since 1939 titanium dioxide has been utilized in greater quantity than any other white pigment. The Bureau of Mines is not at liberty to publish figures on titanium pigments. According to information received from a leading manufac-

turer, the use pattern was unchanged in 1946 from 1945, when he estimated that 75 percent was used for paint, varnish, and lacquer, 10 percent for paper, 2 percent each for floor coverings and rubber, 1½ percent each for welding-rod coatings and textiles, and 8 percent for other uses.

Testimony in the United States Department of Justice antitrust suit against factors in the titanium-pigments industry brought out that production of titanium pigments in the United States had risen from 100 tons (TiO_2 content) in 1920 to about 128,000 tons in 1941 and was 110,000 tons in 1943. Estimated foreign production was about 1,000 tons in 1920 and 23,000 in 1938.

Welding-Rod Coatings.—Production of titanium-coated welding rods was 133,000 short tons in 1946, marking a continuation of the decline since 1943 and the smallest total since before 1941; 267,000 tons were produced in 1945, 382,000 in 1944 and 481,000 in 1943. Of these rods in 1946, 53 percent were coated with natural rutile, 33 percent with manufactured titanium dioxide (extracted from ilmenite), 8 percent with both varieties of dioxide, and 6 percent with ilmenite. The drop in welding-rod output was due to termination of war demand.

Titanium Alloys.—Titanium alloys are discussed in a report described under Technology.

Other Uses.—Titanium in the form of metal had been available in only very small quantities prior to recent experimental work by the Bureau of Mines (see section on Technology). The Bureau's report stated that the large-scale use of ductile metallic titanium would appear to depend only on its availability in suitable form and at a price no longer marking it a rare and precious metal.

STOCKS

Ilmenite and rutile stocks increased 40 and 46 percent, respectively, during 1946.

Stocks of titanium concentrates in the United States at end of year, 1945–46, in short tons

Stocks	1945				1946			
	Ilmenite		Rutile		Ilmenite		Rutile	
	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content
Mine	1,570	774	594	558	1,309	613	533	501
Distributors [1]	6,780	3,254	4,064	3,739	3,919	2,155	8,488	7,979
Consumers	264,248	131,732	1,581	1,464	375,998	195,541	1,896	1,521
Government			3,891	3,658			3,891	3,658
Total stocks	272,598	135,760	10,130	9,419	381,226	198,309	14,808	13,659

[1] Includes ilmenite and rutile content of mixed zirconium-titanium concentrates.

PRICES

Ilmenite, 60 percent TiO_2, continued to be nominally quoted at $28–$30 a long ton, f. o. b. Atlantic seaboard, until June 1946, when 57–60 percent TiO_2 was quoted at $24–$26; in November it dropped

to $22–$24 and in December to $19–$20 a long ton. Rutile, 94 percent TiO_2, remained at 8–10 cents a pound. Steel quoted ferrotitanium, ton lots, at $1.23 per pound of contained Ti for 40- to 45-percent grade and $1.35 for 20- to 25-percent grade; and ferrocarbontitanium, 15–20 percent Ti at $142.50 a short ton for 6- to 8-percent carbon and $157.50 for 3- to 5-percent carbon. Titanium metal, 96–98 percent, was listed at $5–$5.50 a pound. The price of manufactured titanium dioxide remained at 14½–16½ cents a pound.

FOREIGN TRADE [4]

Imports.—Ilmenite imports in 1946 increased 15 percent compared with 1945. India furnished 90 percent of the entries in 1946; but, except for a small quantity in October, there were no receipts from that country in the last 7 months of the year. Entries from Norway increased during the year. Imports of rutile dropped 45 percent to the lowest level since 1940. Titanium is imported from Australia only in the form of mixed zircon-rutile-ilmenite concentrates, which are separated into their component minerals by the International Titanium Corp. (subsidiary of the American Rutile Corp. and Ventures, Ltd.), Carteret, N. J.; Orefraction, Inc., Pittsburgh, Pa.; and Titanium Alloy Manufacturing Co., Niagara Falls, N. Y. Four short tons of ferrotitanium and 12 tons of titanium potassium oxalate were imported in 1946.

Titanium concentrates [1] imported for consumption in the United States, 1942–46, by countries, in short tons

Country of origin	1942	1943	1944	1945	1946
ILMENITE					
Australia [2]	235	390	79	1,753	
Brazil	1,287		5,511	10,508	2
Canada	4,540	65,437	32,580	6,981	1,250
Ceylon			4,648		
India and Dependencies	1,165	8,960	62,066	179,693	218,623
Norway				9,895	21,077
Portugal					
Total as reported	7,227	74,787	104,884	208,830	240,952
Australia: In "zirconium ore" [2]	3,180	3,306	4,064	[3] 1,236	1,388
Grand total	10,407	78,093	108,948	210,066	242,340
Value of "As reported"	$60,490	$380,161	$596,034	$1,217,317	$1,440,112
RUTILE					
Australia [2]	1,311	2,802	1,896	3,070	4,377
Brazil	4,966	4,920	1,669	234	31
Cameroun (French) [4]	146	1,095			
India and Dependencies		818	134		
Total as reported	6,423	9,635	3,699	3,304	4,408
Australia: In "zirconium ore" [2]	4,102	4,703	6,320	7,298	1,456
Grand total	10,525	14,338	10,019	10,602	5,864
Value of "As reported"	$623,917	$823,624	$272,283	$98,170	$213,795

[1] Classified as "ore" by the U. S. Department of Commerce.
[2] All imports of titanium from Australia in 1942–46 were in mixed zircon-rutile-ilmenite concentrates. Totals of mixed concentrates are derived by addition of the U. S. Department of Commerce figures for imports of ilmenite, rutile, and "zirconium ore" from Australia. These totals are apportioned by the Bureau of Mines (on the basis of surveys of importers) into the three component minerals. The excess quantities of ilmenite and rutile over the quantities reported by the U. S. Department of Commerce in those specific categories are entered as "In 'zirconium ore.'"
[3] Includes 309 tons not recovered from mixed concentrates.
[4] Includes quantities reported by the U. S. Department of Commerce as originating in French Equatorial Africa, from which no rutile production has been recorded.

[4] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Exports.—Of the concentrates exported in 1946, 32 percent went to Canada, 22 percent to Sweden, 22 percent to the United Kingdom, 7 percent to Netherlands, and 7 percent to Switzerland. Of the pigments, 74 percent went to Canada and 13 percent to Latin America (largely Brazil, Cuba, Mexico, and Argentina). Practically all of the ferro-alloys went to Canada. Total titanium products exported in 1946 were valued at $3,400,000.

Exports of titanium products from the United States, 1942–46, by classes

Year	Concentrates		Ferro-alloys [1]		Dioxide and pigments		Tetrachloride and other compounds	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1942	618	$117,886	422	$60,938	8,870	$1,707,433	24	$13,666
1943	576	103,947	760	117,402	9,765	1,830,344	728	442,591
1944	291	51,828	793	127,145	10,925	1,851,457	375	215,696
1945	609	121,951	744	122,887	12,824	2,315,552	75	46,718
1946	1,385	200,866	550	63,723	16,314	3,092,607	[2]	[2]

[1] Includes metal and nonferrous alloys, 1942–44.
[2] Beginning Jan. 1, 1946, not separately classified.

TECHNOLOGY

Historical data on the technology of metallic titanium and its alloys and original research work of the Bureau of Mines in this connection were recently summarized by Dean and Silkes.[5] In a press notice announcing the report the Bureau said:

Still considered expensive to produce even under the improved method employed at the Bureau's Intermountain Experiment Station at Salt Lake City, Utah, pure titanium is a light corrosion-resistant metal that combines the properties of stainless steel with those of the strong aluminum alloys. * * *

Until about 1900, efforts to produce pure titanium were unsuccessful, but subsequently a number of methods were developed, one of which was modified by Bureau metallurgists and now attains a production of 100 pounds of metal a week at the Bureau's Boulder City, Nev., pilot plant. In the modified process, titanium is obtained by reducing titanium tetrachloride with pure molten magnesium in the presence of helium under slight pressure.

Ranking ninth in abundance among the elements, titanium places fourth among metallic elements suitable for engineering purposes, and is exceeded only by aluminum, iron, and magnesium. The metal is about twice as heavy as magnesium, which is slightly lighter than aluminum.

One of the outstanding properties which gives pure titanium an advantage over certain other metals is its relatively high proportional limit, a measure of the metal's elasticity. Bureau metallurgists have determined that the proportional limit of cold-worked titanium is as high as 75,000 pounds per square inch, compared with the unusually low proportional limit of stainless steel, which is reported to be not more than 25,000 pounds even when fully cold worked.

Because titanium thus offers a minimum weight where continued high stress is concerned, its use has been suggested in many parts of aircraft design and in a variety of diaphragms that are maintained under tension, particularly microphone diaphragms where weight is important. A considerable saving in power is predicted in the use of the light metal in textile machinery for high-speed spindles, spools, warp beams, and other working parts.

The fact that titanium can be surface hardened is important in the construction of parts subject to frictional wear and its lightness and strength, coupled with an expansion property a little less than that of cast iron, make titanium an ideal material for automotive pistons. Other metals, however, possess better

[5] Dean, R. S., and Silkes, B., Metallic Titanium and Its Alloys: Bureau of Mines Inf. Circ. 7381, 1946, 38 pp.

qualities for piston heads than titanium because of its less favorable heat conductivity.

Among other experimental uses for titanium, not fully tested because of the scarcity of the pure metal, are in sports goods such as tennis rackets and fishing rods; for spring balances and springs where a considerable extension in relatively low loads is desired; for marking glass; for tool mountings, and in the making of pen points and styluses.

WORLD REVIEW

Available data on world production of ilmenite and rutile in recent years are shown in the accompanying table. Brief notes on certain important producing and consuming countries follow.

World production of titanium concentrates (ilmenite and rutile), 1940–46, by countries, in metric tons

[Compiled by B. B. Mitchell]

Country	1940	1941	1942	1943	1944	1945	1946
ILMENITE							
Australia:							
New South Wales	1,538	3,521	3,651	3,815	3,590	(1)	(1)
Queensland		258	937	1,902	3,697	3,000	(1)
Brazil (exports)	12	4,471			3,250	5,000	(1)
Canada	4,114	11,477	9,100	62,992	30,820	12,834	1,227
Egypt	465	2	[2] 691		9	9	
Federated Malay States (exports)	2,596	(1)	(1)	(1)	(1)	(1)	(1)
India, British	267,376	131,111	49,977	38,396	102,412	(1)	(1)
Norway	51,700	61,086	60,713	66,191	63,975	(1)	(1)
Portugal	899	798		121		301	(1)
Senegal [3]	7,082	1,000	4,840	730		3,200	(1)
Spain		71	85	178	548	216	(1)
United States	18,750	21,135	70,042	184,657	252,749	279,880	256,230
Total ilmenite	354,532	236,930	200,036	358,982	461,050	(1)	(1)
RUTILE							
Australia:							
New South Wales	1,641	3,549	4,496	4,828	4,597	(1)	(1)
Queensland		267	1,007	1,655	4,246	4,000	(1)
South Australia	2	[4]					(1)
Brazil (exports)	499	2,369	4,615	4,557	1,564	160	(1)
Cameroun, French (exports)	503	1,399	2,153	2,750	2,902	1,046	(1)
India	934	1,891	2,295	2,396	1,672	(1)	(1)
Norway	156	172	77	116	85	(1)	(1)
United States	2,620	2,839	2,402	3,617	6,279	6,513	6,761
Total rutile	6,355	12,486	17,045	19,919	21,345	(1)	(1)

[1] Data not available. Estimates for individual countries included in world totals shown.
[2] Includes 26 tons of garnet-ilmenite.
[3] Approximately 20 percent of ilmenite concentrates is zircon.
[4] Less than 1 ton.

Australia.—A recent report [6] indicated that the naturally concentrated sands containing rutile, zircon, and ilmenite, among other minerals, occur at intervals along 300 miles of the east coast between Coff's Harbour, New South Wales, and Tin Can Bay, Queensland. According to the report, the main output has come from deposits in the 50-mile stretch from Byron Bay, New South Wales, to Southport, Queensland. Preliminary investigations on a laboratory scale, with a view to improvement of plant practice, have recently been carried out at the metallurgical laboratory, University of Melbourne, by the Council for Scientific and Industrial Research.[7]

[6] Chemical Engineering and Mining Review, Recovery of Rutile and Zircon from Beach Sands: Vol. 38, No. 456, Sept. 10, 1946, pp. 451–454.
[7] Queensland Government Mining Journal, vol. 47, No. 541, November 1946, p. 325.

Egypt.—Egypt has deposits of hundreds of thousands of tons of ilmenite. Black sands at the mouth of the Nile contain monazite and zircon.[8]

Germany.—The titanium industry in Germany was summarized in a recent report.[9] The report is quoted in part as follows:

> The surprisingly extensive wartime research and patent applications of Titangesellschaft G. m. b. H., the only German manufacturers of titanium dioxide, represent thought-provoking viewpoints in this field. The comprehensive development of vitreous enamels based on titanium in place of boron is claimed not to provide merely a substitute for borax but, rather, products permitting better enamels and the use of fewer coats, with corresponding production economies. Titanium dielectrics and resistors as developed, or under investigation in Germany, seem to offer unusual possibilities in the fields of radio and electrical and electronic circuits and apparatus. Titanium carbide as a constituent of cemented carbide cutting tool tips seems to have made a place for itself beyond that of a mere substitute in high speed finishing cuts where minimum wear is important.

Titangesellschaft G. m. b. H. was the sole producer of titanium dioxide and titanium tetrachloride in Germany, and the output of titanium dioxide at the Leverkusen plant, near Cologne, for 1940–42, in metric tons, was as follows:

	Ore consumed (dry basis)	*Titanium dioxide produced (equivalent TiO_2)*
1940	30, 234	11, 730
1941	34, 927	13, 153
1942	39, 235	15, 323

A representative wartime distribution of an output of 1,200 tons a month of titanium dioxide was as follows:

	Metric tons
Paints and similar materials	300
Welding rods and metallurgy	300
Vitreous enameling, mainly flux	100
Paper manufacture	100
Silk delustering	100
Electrical ceramics	50
Titanium tetrachloride (manufactured)	50
Export to European countries	200
	1, 200

Except for a few experimental batches the pigment-grade TiO_2 was exclusively of the anatase crystal modification, whereas the rutile type was desired for welding-rod coatings and electrical ceramic purposes.

Titanium tetrachloride was produced in 1943–44 at a rate of 100 tons a month, presumably primarily for producing fogs for screening military movements.

Another report[10] stated that production ceased completely on October 26, 1944, owing to major damage sustained in a daylight bombing raid. Production was resumed on a limited scale in December 1945. The plant equipment did not sustain as much damage as the plant structure.

[8] Herlihy, Matin, Egypt's Minerals: Min. Jour., vol. 226, No. 5776, May 4, 1946, p. 345.
[9] McBerty, Ford H., Titanium Products in Germany: Office of Military Government for Germany (United States) Fiat Final Report 773, May 3, 1946, 61 pp.
[10] British Intelligence Objectives Sub-Committee Final Report, Titanium Pigments, Titangesellschaft, Leverkusen: No. 451, p. 2.

India.—A pilot plant to produce titanium dioxide from bauxite sludge has been established in the laboratories of the Council of Scientific and Industrial Research, Delhi, India.[11] Arrangements for a pigment factory in Travancore, South India, have been completed. The government of Travancore will have sole ownership and control of mining, exporting, and processing of all mineral sands.[12]

Malaya.—There are about 300,000 tons of ilmenite collected in dumps in the tin fields of North Malaya from alluvial tin mining.[13]

Norway.—Deposits located south of Stavanger supplied virtually all of the ilmenite required for titanium products produced in Germany, according to a recent report.[14] The report said that ore reserves were said to exceed 30 million tons, with a titanium dioxide content of 25 to 40 percent. A representative analysis of the product exported to Germany was as follows following concentration: 44.40 percent TiO_2, 34.00 percent FeO, 12.44 percent Fe_2O_3, 0.63 percent FeS, 2.79 percent SiO_2, 3.55 percent MgO, 0.37 percent MnO, 0.175 percent V_2O_5, 0.085 percent NiO, 0.015 percent CuO, 0.015 percent P_2O_5, and less than 0.01 percent Cr_2O_3.

United Kingdom.—Paint shortage and increased demand necessitated a paint-distribution plan effective August 1, 1946. Several projects are afoot for new titanium pigment factories.[15] About 3,000 to 4,000 tons of rutile are consumed annually.[16]

[11] Foreign Commerce Weekly, vol. 24, No. 7, Aug. 17, 1946, p. 55.
[12] The Mining Journal (London), vol. 227, No. 5802, Nov. 2, 1946, p. 868.
[13] Willbourn, E. S., The Relationship of the Geological Survey to the Mining Industry of Malaya: Bull. Imperial Inst., vol. 44, No. 2, April-June 1946, p. 131.
[14] McBerty, Ford H., work cited in footnote 9, p. 1.
[15] Chemical and Process Industries, vol. 30, No. 7, July 1946, p. 50.
[16] Metal Bulletin, No. 3085, Apr. 9, 1946, p. 16.

Tungsten

By HUBERT W. DAVIS

GENERAL SUMMARY

PRODUCTION, shipments, and consumption of tungsten concentrates in the United States continued their downward trends in 1946, declining for the third consecutive year, but imports for consumption were greater than in 1945. Because of the lessened demand there was some weakening in price.

Output of tungsten concentrates in the first quarter of 1946 exceeded the quarterly average rate in 1945 and was also greater than the domestic consumption rate for the first quarter of 1946. To conform to the lessened demand, the operating rates at most of the larger mines and treatment plants were contracted, and production declined progressively through the last three quarters of 1946. Total production of tungsten concentrates dropped to 4,908 short tons (60 percent WO_3 basis) in 1946 compared with 5,662 tons (revised figure) in 1945. Domestic production was equivalent to 72 percent of United States consumption in 1946. A substantial part of the 1946 output was produced for the Government stock pile by the Government-owned Salt Lake City chemical plant, which discontinued operations in the third quarter.

Salient statistics of tungsten ores and concentrates in the United States, 1942–46, in pounds of tungsten

Year	Production	Shipments from mines	General imports (receipts)	Consumption	Industry stocks at end of year		
					Consumers and dealers	Producers	Total
1942	8,977,575	8,882,403	15,409,814	17,389,000	3,416,438	355,864	3,772,302
1943	11,472,985	11,368,295	18,678,426	19,313,000	2,459,246	458,586	2,917,832
1944	9,764,647	9,786,537	18,238,890	19,165,000	1,510,419	435,634	1,946,053
1945	[1] 5,388,639	[1] 5,266,818	8,639,374	14,146,000	3,784,429	[1] 557,042	[1] 4,341,471
1946	4,671,042	4,942,282	6,811,099	6,458,000	3,694,256	285,865	3,980,121

[1] Revised figure.

Receipts of imported tungsten ores and concentrates into the United States were 7,157 short tons (60 percent WO_3 basis) in 1946, a decline of 21 percent from 1945. Bolivia (37 percent) and Brazil (18 percent) were the chief sources of imports in 1946, but important quantities were also received from Southern Rhodesia and the United Kingdom. However, imports for consumption, which represent the concentrates entering into the domestic commerce of the United States,

were 7,218 tons (60 percent WO_3 basis), an increase of 44 percent over 1945.

Tungsten concentrates were consumed at an average rate of about 1,450 short tons (60 percent WO_3) during the first three quarters of 1946. In the fourth quarter, however, there was a sharp gain in usage, owing largely to a swing back to "18–4–1" type (18 percent tungsten, 4 percent chromium, and 1 percent vanadium) of high-speed steel for the tool requirements of some companies which had been using "6–6" (6 percent tungsten and 6 percent molybdenum) or molybdenum-type high-speed steel. Also contributing to the fourth-quarter gain was the inception of operation at the refinery at Henderson, Nev., where low-grade tungsten concentrates are processed chiefly to tungstic acid, ammonium paratungstate, and artificial scheelite. Notwithstanding the fourth-quarter rise, consumption of tungsten concentrates was only 6,800 short tons (60 percent WO_3) in 1946—a 54-percent drop from 1945.

Figure 1 shows trends in domestic shipments, imports, and prices of tungsten ores and concentrates since 1915.

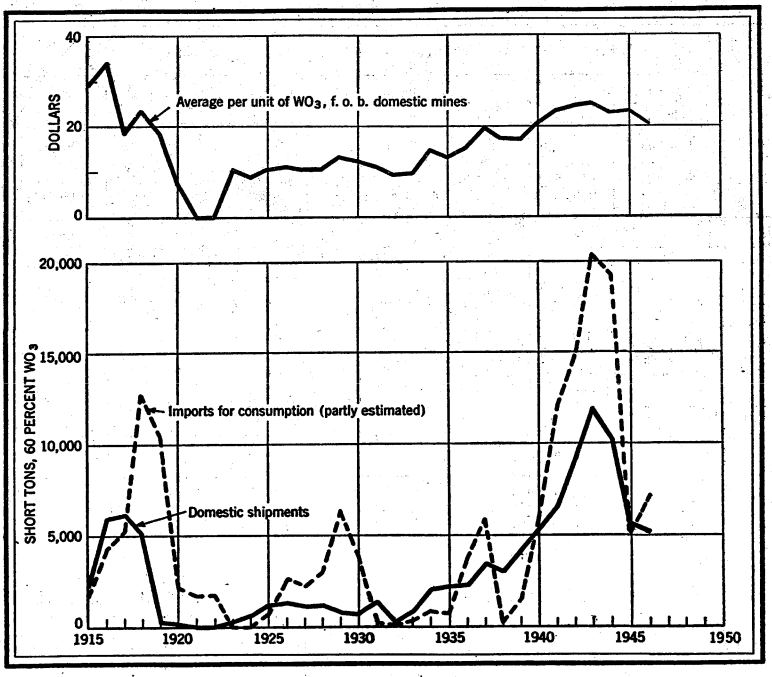

FIGURE 1.—Trends in domestic shipments, imports, and average price of tungsten ores and concentrates, 1915–46.

DOMESTIC PRODUCTION

The tungsten ore mined and milled in the United States, in general, contains 0.5 to 2.5 percent WO_3 and is beneficiated to a concentrate containing 60 percent or more WO_3. Scheelite (calcium tungstate) is the tungsten mineral in most domestic ore mined. The leading tung-

sten producers and many small operators depend on ore carrying tungsten only as scheelite. Ferberite (iron tungstate), hübnerite (manganese tungstate), and wolframite (iron-manganese tungstate), in the order listed, contribute a comparatively small part of the tungsten in domestic ore. Most of the concentrates are converted to ferrotungsten and tungsten metal. Some high-purity concentrates, however, are charged directly to the steel bath. Wolframite is preferred for the filaments in electric-light bulbs and radio tubes.

Smaller demand for tungsten in 1946 resulted in a decline in production of concentrates to 4,908 short tons (60 percent WO_3 basis), as compared with 5,662 tons (revised figure) in 1945. Output was obtained from many widely scattered operations in 11 States and Alaska, but 4 States—California, Idaho, Nevada, and North Carolina—supplied 93 percent of the total, and 5 operators (Bradley Mining Co., Nevada-Massachusetts Co., Office of Metals Reserve, Tungsten Mining Corp., and United States Vanadium Corp.) produced 85 percent of the United States total.

Tungsten concentrates produced and shipped in the United States, 1945–46, by States [1]

State	Produced				Shipped from mines			
	1945		1946		1945		1946	
	Short tons, 60 percent WO_3	Units	Short tons, 60 percent WO_3	Units	Short tons, 60 percent WO_3	Units	Short tons, 60 percent WO_3	Units
Alaska			26	1,583			19	1,129
Arizona	97	5,848	20	1,211	97	5,848	20	1,211
California	1,049	62,951	1,258	75,467	1,073	64,380	1,262	75,735
Colorado	252	15,136	208	12,473	234	14,022	213	12,754
Idaho	2,029	121,702	538	32,310	2,130	127,787	641	38,458
Montana	[2] 28	[2] 1,688	55	3,306	([3])	4	84	5,047
Nevada	[2] 2,059	[2] 123,532	2,475	148,483	[2] 1,857	[2] 111,431	2,617	157,069
North Carolina	139	8,314	298	17,908	132	7,914	307	18,434
South Dakota	3	189	1	39	4	226	1	39
Texas			1	45			1	45
Utah	5	319	27	1,636	5	319	27	1,636
Washington	1	69	1	30	2	125	1	30
	[2] 5,662	[2] 339,748	4,908	294,491	[2] 5,534	[2] 332,056	5,193	311,587

[1] Excludes secondary concentrates produced as feed for chemical-treatment plants at Salt Lake City, Utah, and Bishop, Calif. Instead, the primary concentrates produced therefrom, as well as shipped, are included. The figures for 1946, however, include the secondary concentrates produced and shipped to the refinery at Henderson, Nev.

[2] Revised figure. [3] 147 pounds.

Tungsten concentrates shipped from mines in the United States, 1942–46

Year	Quantity		Reported value f. o. b. mines		
	Concentrates, 60 percent WO_3 (short tons)	Tungsten content (pounds)	Total	Average per unit of WO_3	Average per pound of tungsten
1942	9,333	8,882,403	$13,508,266	$24.12	$1.52
1943	11,945	11,368,295	17,973,685	25.08	1.58
1944	10,283	9,786,537	14,407,143	23.35	1.47
1945	[1] 5,534	[1] 5,266,818	[1] 7,692,691	[1] 23.17	1.46
1946	5,193	4,942,282	6,283,413	20.17	1.27

[1] Revised figure.

Tungsten concentrates shipped from mines in the United States, 1910–46, by States, in short tons of 60 percent WO_3

Year	Arizona	California	Colorado	Idaho	Montana	Nevada	North Carolina	South Dakota	Utah	Washington	Other States [1]	Total
1910	17	480	1,221					[2]		103		1,821
1911	50	314	730	22		22				1		1,139
1912	27	462	812	20		8					1	1,330
1913	16	541	953	14		3		1		1	8	1,537
1914	15	489	467	9					1		9	990
1915	127	962	963	32		55		140	4	1	48	2,332
1916	218	2,171	2,401	101	1	689		239	20	11	72	5,923
1917	150	2,781	2,707	2	16	143		270	33	10	32	6,144
1918	213	1,791	1,910		22	898		201	7	1	18	5,061
1919	50	147	130									327
1920			216									216
1921												
1922												
1923			241									241
1924		219	123			117		106				565
1925	9	574	201			407						1,191
1926	25	490	232			545		90				1,382
1927	2	307	332		10	372		141				1,164
1928		335	229			551		86			7	1,208
1929	20	150	152			503		5				830
1930	1	117	47		31	499				7		702
1931	98	35	98			1,167				6		1,404
1932	62	32			30	241				31		396
1933	42	174	86			550				43		895
1934	258	239	342	1		1,044				164	1	2,049
1935	394	200	390			1,219				192		2,395
1936	489	253	180	11	[2]	1,631				48	[2]	2,612
1937	349	577	219	99	14	2,153			24	64	1	3,500
1938	37	839	240	154		1,461			7	303	3	3,044
1939	100	1,263	479	228	23	2,091			3	100		4,287
1940	349	2,070	693	260	50	1,796			14	74	13	5,319
1941	277	2,603	631	656	7	2,289		2	30	68	4	6,567
1942	219	3,483	376	2,108	[2]	3,052			29	43	23	9,333
1943	62	3,871	378	4,648		2,910	40		21	4	11	11,945
1944	29	3,027	296	4,005	25	2,665	186	7	9	5	29	10,283
1945	97	1,073	234	2,130	[2]	[3] 1,857	132	4	5	2		[3] 5,534
1946	20	1,262	213	641	84	2,617	307	1	27	1	20	5,193

[1] Alaska, Connecticut, Missouri, New Mexico, Oregon, and Texas.
[2] Less than half ton.
[3] Revised figure.

In 1946, as in previous years, the secondary concentrates produced as feed for the chemical-treatment plants at Salt Lake City, Utah, and Bishop, Calif., have not been included in the statistics. Instead, the resulting primary concentrates recovered (as well as shipped) each year have been credited in the statistics to the State of origin. However, the low-grade concentrates produced and shipped to the refinery at Henderson, Nev., have been included in the figures for 1946.

Alaska.—Production of concentrates in Alaska was 28 short tons averaging 57 percent WO_3 in 1946; this output includes 15 tons of concentrate averaging 74.16 percent WO_3, recovered at the Salt Lake City, Utah, plant from treating secondary concentrates that were produced in 1944.

J. H. Scott Co., operating the Riverside mine near Hyder, produced (but did not ship) 13 short tons of concentrate averaging 31.9 percent WO_3 in 1946.

In the course of exploration work at the Big Chief mine near Fairbanks, the Yukon Corp. produced a few hundred pounds of concentrate averaging 63.4 percent WO_3 in 1946.

Arizona.—Production and shipments of tungsten concentrates in Arizona were 17 short tons averaging 71.24 percent WO_3 in 1946 compared with 140 tons averaging 41.77 percent WO_3 in 1945. The 1946 figures include 8 tons of concentrate averaging 74.16 percent WO_3, recovered at the Salt Lake City, Utah, plant from treating secondary concentrates produced previous to 1946. The remainder of the small output in 1946 came from several widely scattered operations.

California.—California ascended from third to second place as a tungsten-producing State in 1946. Output of concentrates was 5,607 short tons averaging 13.46 percent WO_3 in 1946 compared with 1,140 tons averaging 55 percent in 1945. Shipments of tungsten concentrates totaled 5,525 tons averaging 13.71 percent WO_3 in 1946 compared with 1,186 tons averaging 54.28 percent WO_3 in 1945. The lower WO_3 content of the concentrates produced and shipped in 1946 resulted from a change in the operating procedure at the Pine Creek mine in April. Although concentrates were produced at a number of widely scattered operations, 6 producers (Alpine Mining Co., Benware & Singley, Consolidated Tungsten, Hoefling Bros., Tulare County Tungsten Mines, and United States Vanadium Corp.) supplied 93 percent of the State total. The bulk of the remainder was contributed by Darwin Mines, El Diablo Mining Co., Embree & Eliason Mining Co., and Sheridan, Bennett & Kidder.

The Pine Creek mine of United States Vanadium Corp. near Bishop resumed production of ore in April; the ore is transported to the mine concentrator over a recently completed 2½-mile aerial tramway. The Pine Creek concentrator was operated at a greatly increased rate in 1946; as a consequence, production of concentrates about doubled that in 1945. The bulk of the output in 1946 was a low-grade flotation concentrate, which was shipped to the company refinery at Henderson, Nev., where it will be processed chiefly to tungstic acid, ammonium paratungstate, and artificial scheelite. The concentrator feed comprised ore from the Pine Creek mine and secondary concentrates, chiefly from the Yellow Pine mine in Idaho, the Mill City mill in Nevada, and the Riley mine in Nevada. The concentrates recovered from the treatment of secondary concentrates originating in Idaho and Nevada have been credited in the statistics to those States.

Hoefling Bros. continued to work the Spud Patch and other placers in San Bernardino County, but its output of concentrate in 1946 was 53 percent less than in 1945.

The Big Jim mine in Tulare County, operated by the Tulare County Tungsten Mines, was also worked at a reduced rate in 1946, but the Harrel Hill mine, also in Tulare County, operated by Consolidated Tungsten, produced at about the same rate as in 1945. In late 1946 Embree & Eliason Mining Co. completed a mill to serve its Sherman Peak mine in Tulare County, and a small quantity of concentrate was produeed and sold.

A mill to serve the Alpine mine in Alpine County was put into operation in May 1946 by the Alpine Mining Co., which produced (but did not market) 55 short tons of concentrate averaging about 60 percent WO_3.

The El Diablo Mining Co. resumed mining at the Brownstone mine in Inyo County in 1946.

Colorado.—Production and shipments of concentrates (60 percent WO_3 basis) in Colorado were 208 and 213 short tons, respectively, in 1946 compared with 252 and 234 tons, respectively, in 1945. The 1946 production and shipment figures include 116 tons of concentrate averaging 74.16 percent WO_3, recovered at the Salt Lake City, Utah, plant from the treatment of secondary concentrates originating in Colorado.

The Boulder Tungsten Mills, Inc., continued to treat ore purchased from the Office of Metals Reserve until February 1, 1946, when operations ceased; the mill was sold to Consolidated Caribou Silver Mines, Inc., and the remaining ore was disposed of to Geo. H. Teal & Associates.

The Conger mine was reopened by Tanner & Smith, who made a small output of concentrate in 1946.

The mill of Geo. H. Teal & Associates operated on purchased ore in 1946. The Red Signe mine was being opened.

The Firth-Sterling Steel Co. (Wolf Tongue Division) treated ore produced chiefly by lessors.

Idaho.—Production of concentrates in Idaho was 439 short tons averaging 74 percent WO_3 in 1946 compared with 1,727 tons averaging 70 percent WO_3 in 1945. Shipments also declined to 531 tons averaging 72 percent WO_3 in 1946 compared with 1,852 tons averaging 69 percent WO_3 in 1945. The figures include the concentrate recovered from treating Yellow Pine secondary concentrate at the plant of the United States Vanadium Corp. near Bishop, Calif.

Production of concentrate at the Ima mine in Lemhi County, operated by the Bradley Mining Co., was 17 percent less than in 1945. The purification plant of the Bradley Mining Co. at Boise was dismantled and sold in 1946.

Montana.—The H. & H. Mines continued to work the gravel containing scheelite and gold in lower Henderson Creek near Hall, Granite County, in 1946; production of concentrate was 45 short tons averaging 60 percent WO_3 and shipments were 76 tons averaging 61 percent WO_3.

The Jardine Mining Co. recovered 9 short tons of scheelite concentrate averaging 72 percent WO_3 in 1946.

Nevada.—Nevada again was the premier tungsten-producing State. Production of concentrates was 4,034 short tons averaging 37 percent WO_3 in 1946 compared with 1,740 tons (revised figure) averaging 71 percent in 1945. Shipments likewise declined and were 4,149 tons averaging 38 percent WO_3 in 1946 compared with 1,588 tons (revised figure) averaging 70 percent in 1945. The 1946 production and shipment figures include 737 and 752 tons, respectively, of concentrate averaging 74 percent WO_3, which were recovered at the Salt Lake City, Utah, plant from treating Nevada secondary concentrates. In addition, the concentrate recovered in California from treating Nevada secondary concentrates has been credited to Nevada in the statistics.

The Nevada-Massachusetts Co. and its affiliate, Rare Metals Corp., continued to be the chief producers in Nevada, but output was 22 percent less in 1946 than in 1945. In 1946 they operated the treatment plants at Mill City and Toulon; the latter plant suspended operations March 31. The feed for the Mill City plant was provided

by the Stank, Humboldt, and Sutton No. 2 mines and from treatment of old magnetic-reject dumps. In the Sutton No. 2 mine the shaft was sunk farther, and more mucking machines were added. Development by tunnels was under way in the new O'Byrne mine, near the Stank. In the mill a new bin and conveyor system was installed for the No. 2 ball mill, and a new 4-foot Symons crusher was being added to the crushing plant.

Smaller producers of concentrates in 1946 were the United States Vanadium Corp., operating the Riley mine in Humboldt County; Nevada Scheelite, Inc., operating a mine of the same name in Mineral County; and the Cherry Creek Tungsten Co., operating the Cherry Creek mine in White Pine County. The milling plant of Nevada Scheelite, Inc., was destroyed by fire June 10, 1946; it was being rebuilt. Production was discontinued at the Cherry Creek mine in June 1946, and output at the Riley mill was suspended temporarily in the latter part of the year.

The flotation plant of Getchell Mine, Inc., Red House, Nev., which since August 1945 had been treating, under toll agreement with the Office of Metals Reserve, the stock piles of tungsten ore in the vicinity of the mill, completed milling for that agency in April 1946. During January–April 1946, 35,057 tons of ore were milled, which yielded 1,643 tons of concentrate averaging 13.02 percent WO_3. The concentrate was shipped to the chemical plant at Salt Lake City for further treatment. Getchell Mine, Inc., also mined and treated 18,629 tons of ore which yielded 292 tons of concentrate averaging 13.92 percent WO_3; the concentrate was shipped to the refinery at Henderson.

At Henderson a refinery was completed and put into operation the latter part of 1946 by the United States Vanadium Corp. At this plant concentrates containing 8 to 50 percent WO_3 from the company Pine Creek and Riley mines, near Bishop, Calif., and Winnemucca, Nev., respectively, and custom concentrates from other properties, will be processed—chiefly to tungstic acid, ammonium paratungstate, and artificial scheelite—either by the acid treatment or pressure digestion treatment.

North Carolina.—The Tungsten Mining Corp., operating the Hamme mine in Vance County, produced 349 short tons of concentrate averaging 51.27 percent WO_3 in 1946 compared with 219 tons averaging 37.89 percent WO_3 in 1945.

The Seminole Rock & Sand Co., successor to the Southern Aggregates Corp., did no mining at its property, also in Vance County.

Utah.—The Government-owned chemical-treatment plant at Salt Lake City discontinued operations in the third quarter of 1946, when the operating agreement with United States Vanadium Corp. terminated. In 1946 it treated 5,805 tons of concentrates averaging 13.24 percent WO_3. The plant feed comprised secondary concentrates, chiefly from the mill of Getchell Mine, Inc. The resultant concentrates produced and shipped in 1946 have been credited in the statistics to Alaska, Arizona, Colorado, Nevada, South Dakota, Texas, Utah, and Washington. The Salt Lake City chemical-treatment plant began operating in April 1943; since then it has treated 34,703 tons of concentrates averaging 11.76 percent WO_3, which

yielded 5,448 tons of concentrates averaging 68 percent WO_3. The plant feed comprised chiefly secondary concentrates from the Yellow Pine mine in Idaho of Bradley Mining Co. and the mill in Nevada of Getchell Mine, Inc.; but concentrates from Alaska, Arizona, California, Colorado, Utah, and other mines in Nevada furnished a substantial part of the total.

CONSUMPTION

Consumption of tungsten concentrates in the United States was about 6,800 short tons (60 percent WO_3 basis) in 1946 compared with 14,900 tons in 1945. Of the total consumed in 1946, about 2,400 tons (35 percent of the total) were converted to ferrotungsten, the form in which most of the tungsten is introduced into steel. However, high-purity tungsten concentrates are charged directly to the steel bath; and 1,900 tons (28 percent) were so used in 1946. Tungsten-metal powder and other tungsten products, chiefly the former, employed about 2,500 tons or 37 percent of the total concentrates consumed in 1946. The accompanying table shows the production of tungsten products in the United States in 1945 and 1946.

Production of specified tungsten products in the United States, 1945–46, in pounds

Product	1945		1946	
	Gross weight	Tungsten content	Gross weight	Tungsten content
Ferrotungsten	8,214,504	6,545,277	2,699,926	2,089,608
Tungsten metal powder	4,909,061	4,900,177	1,368,195	1,364,264
Special tungsten alloys	409,040	253,200	434,619	179,030
Sodium tungstate [1]	421,704	236,085	791,255	440,841
Tungstic oxide [1]	599,828	474,092	273,470	216,037
Tungstic acid and ammonium paratungstate [1]	689,889	497,460	211,047	149,143

[1] Figures cover production for sale only and therefore exclude production as an intermediate product of producers. Probably the greater part of the production reported for tungstic acid, tungstic oxide, and ammonium paratungstate is used in making tungsten powder.

PRICES

Quotations on high-quality tungsten concentrates remained steady throughout 1946, but lower-quality concentrates fluctuated considerably. According to the Engineering and Mining Journal, Chinese ore was quoted at $24 a short-ton unit of WO_3, duty paid, and domestic scheelite of good known analysis, in carlots, delivered, at $24 to $24.50 a unit throughout 1946. However, prices on ores and concentrates from Bolivia, Brazil, and other countries were less steady and fluctuated between $24 and $21 a unit, duty paid. The increasing use of high-purity scheelite for direct smelting has placed a premium on this type of concentrate. The average price for domestic concentrates shipped to consumers in 1946, as reported to the Bureau of Mines, was $20.17 a short-ton unit.

FOREIGN TRADE [1]

Domestic production is inadequate for requirements, and the United States imports both tungsten concentrates and products, chiefly the former. General imports (receipts) of ores and concentrates into the United States totaled 6,811,099 pounds (tungsten content), equivalent to 7,157 short tons of 60 percent WO_3 in 1946, a 21-percent decrease from 1945. This quantity represents the ores and concentrates received into the United States, irrespective of final disposition.

Tungsten ores and concentrates imported into the United States, 1945–46, by countries

Country	General imports [1]		Imports for consumption [2]		
	Gross weight (pounds)	Tungsten content (pounds)	Gross weight (pounds)	Tungsten content (pounds)	Value
1945					
Argentina	1,606,326	851,968	1,439,885	764,391	$901,159
Australia	49,177	21,333			
Belgian Congo	304,036	156,726	51,941	27,858	25,787
Bolivia	8,976,072	3,959,432	5,582,594	2,450,771	2,269,888
Brazil	4,389,719	2,298,528	2,367,507	1,316,584	1,186,931
British East Africa	22,141	12,292			
Canada	752	380			
Chile	55,986	29,928			
China	48,656	25,073	48,656	25,073	40,300
Cuba	18,795	8,926			
India and Dependencies	65	33	65	33	51
Mexico	350,463	130,120	258,756	91,137	60,145
New Zealand	270,414	128,899			
Peru	669,347	335,000	187,140	98,014	95,316
Portugal	336,154	157,213			
Southern Rhodesia	420,947	210,308			
Spain	500,760	246,962			
Union of South Africa	127,362	66,253			
	18,147,172	8,639,374	9,936,544	4,773,861	4,579,577
1946					
Argentina	263,118	141,480	265,755	145,178	120,146
Australia	450,982	253,510	23,677	13,729	10,866
Belgian Congo	589,071	307,591	789,544	426,908	390,023
Bolivia	6,029,435	2,488,924	5,842,279	2,525,312	2,097,988
Brazil	2,319,885	1,253,565	3,297,648	1,816,486	1,567,750
British East Africa	19,139	10,190			
Canada	245,906	111,692			
China	358,255	186,822	162,628	82,514	77,442
Cuba			16,968	8,544	8,657
France	551	37	551	37	91
Mexico	104,966	49,814	66,253	31,976	37,783
Netherlands	54,880	31,386	54,880	31,386	25,174
Netherlands Indies	321,809	178,487	222,525	123,075	107,251
New Zealand	35,640	18,577	301,156	154,366	144,505
Peru	433,348	243,583	552,052	307,158	258,894
Portugal	297,502	150,149			
Siam	220,374	113,596	178,883	92,217	41,529
Southern Rhodesia	967,663	488,701	1,735,472	888,599	838,150
Spain	398,384	194,557	227,784	113,526	107,187
Union of South Africa	249,064	127,820	62,322	33,356	25,755
United Kingdom	893,509	460,618	135,385	75,071	69,938
	14,253,481	6,811,099	13,935,762	6,869,438	5,929,129

[1] Comprises ores and concentrates received in the United States; part went into consumption during year, and remainder entered bonded warehouses.
[2] Comprises ores and concentrates withdrawn from bonded warehouses during year (irrespective of time of importation) and receipts during year for consumption.

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Tungsten ores and concentrates imported for consumption in the United States, 1936–46, in short tons of 60 percent WO_3

Country	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946
North America:											
Canada	43						9	68	180		
Cuba					3		8	8			9
Mexico	101	51	1	154	120	84	80	340	431	96	34
	144	51	1	154	123	84	97	416	611	96	43
South America:											
Argentina	12	145		80	801	542	2,604	2,454	2,382	803	152
Bolivia	49	79	1	101	1,270	3,042	7,123	5,356	[1]8,249	2,575	2,653
Brazil						[2]	28	1,193	2,149	1,384	1,909
Chile		9			3				3		
Ecuador				22			[2]				
Peru	40			51	184	343	278	587	[1]1,844	103	323
	101	233	1	254	2,258	3,927	10,033	9,590	14,627	4,865	5,037
Europe:											
Belgium	110	44									
France	2										[2]
Netherlands											33
Portugal					339	390	246	329	44		
Spain											119
Sweden	32	13									
United Kingdom											79
	144	57			339	390	246	329	44		231
Asia:											
British Malaya	459	1,025	71	130	171	33					
Burma				14	98			46	83		
China	2,689	3,987	74	945	1,996	6,909	4,013	9,605	3,810	26	87
Hong Kong	44	19									
India and Dependencies					31		23	177	95	[2]	
Indochina, French				3	15	15	23	133			
Japan	31	63									
Netherlands Indies											129
Siam					207	431		109			97
	3,223	5,094	145	1,092	2,518	7,388	4,059	10,070	3,988	26	313
Africa:											
Belgian Congo						44	155		27	29	449
Egypt							230				
Southern Rhodesia		[3] 29			[2]	[3] 40	50				934
Union of South Africa	14	57	24		56	131	162	19	33		35
	14	86	24		56	215	597	19	60	29	1,418
Oceania:											
Australia	142	322		60	602	103	21	7			14
New Zealand											162
	142	322		60	602	103	21	7			176
	3,768	5,843	171	1,560	5,896	12,107	15,053	20,431	19,330	5,016	7,218

[1] Bureau of Mines estimates that about 82 percent of the quantity credited to Peru in 1944 by the U. S. Department of Commerce originated in Bolivia.
[2] Less than half ton.
[3] Credited to "other British South Africa" by the U. S. Department of Commerce.

Although ores and concentrates were received from 20 foreign countries in 1946, 2—Bolivia (37 percent) and Brazil (18 percent)—supplied 55 percent of the total. However, important quantities were also received from Southern Rhodesia and the United Kingdom. Unsettled conditions in China prevented that country from regaining its important position in the world market.

Imports of ores and concentrates for consumption in the United States were 6,869,438 pounds (tungsten content), equivalent to 7,218 short tons of 60 percent WO_3 in 1946, an increase of 44 percent over

1945. Bolivia and Brazil supplied 37 and 26 percent, respectively, of the 1946 total. Imports for consumption represent ores and concentrates on which the duty has been paid and which have thereby entered into the domestic commerce of the United States.

In 1946, 1,724 tons (60 percent WO_3) of ores and concentrates were withdrawn from warehouses for smelting, refining, and export, and 1,517 tons (gross weight) were reexported. Ores and concentrates withdrawn for smelting, refining, and export and for reexport are free of duty.

The duty on tungsten ores and concentrates is 50 cents a pound on the metallic tungsten contained therein. This is equivalent to $7.93 a short-ton unit.[2]

Exports of domestic tungsten ores and concentrates from the United States are small; 78,473 pounds (gross weight) were exported in 1946 (4,240 pounds in 1945).

Imports of tungsten metal were 11,136 pounds in 1946 (4,396 pounds in 1945). Imports of combinations containing tungsten or tungsten carbide were 2 pounds in 1946 (none in 1945). There were no imports of tungstic acid in 1946 (2,295 pounds in 1945), and no tungsten carbide as such was imported in either year.

Export of tungsten metal, stellite, wire, shapes, and alloys other than ferrotungsten were 138,472 pounds in 1946 (260,435 pounds in 1945). Exports of ferrotungsten were 181,445 pounds in 1946 (861,461 pounds in 1945).

WORLD REVIEW

Argentina.—Argentina was the second-largest producer of tungsten in South America for many years previous to 1945, when it was displaced by Brazil. Production was 450 to 500 metric tons (66 percent WO_3) in 1945; data on output in 1946 are not available but from the meager information at hand it is apparent that production declined substantially.

Australia.—During the year ended October 31, 1946, the King Island Scheelite, N. L., milled 127,415 long tons of scheelite ore, which yielded 582 tons of concentrate averaging 67.5 percent WO_3.[3] In the corresponding year 1945 it milled 89,518 tons of ore which yielded 434 tons of concentrate. The mining and recovery of scheelite by the company has been described in the Chemical Engineering and Mining Review.[4]

Bolivia.—Greatly decreased demand and lower prices following the ending of hostilities resulted in an abrupt decline in production of tungsten in Bolivia; and, as happened after World War I, many mines closed or reduced operations. In an effort to keep mines open, the Bolivian Government waived the export tax on tungsten ore. Output (as indicated by exports) was only 2,120 metric tons (60 percent WO_3 basis) in 1946 compared with 3,851 tons in 1945. Despite the smaller production in 1946, Bolivia continued to be the largest tungsten producer in South America.

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[2] A unit, as applied to tungsten ores, is 1 percent of a ton of contained tungsten trioxide (WO_3). Thus, a short-ton unit is 20 pounds of WO_3 or 15.86 pounds of tungsten (W).

[3] Mining Journal (London), vol. 228, No. 5831, May 24, 1947, p. 285.

[4] Chemical Engineering and Mining Review (Melbourne), Mining and Recovery of Scheelite at King Island: Vol. 38, No. 453, June 10, 1946, pp. 330-338.

Brazil.—Brazil continued to be the second-largest producer of tungsten in South America. Exports of tungsten concentrates were 1,476 metric tons (66 percent WO_3) in 1946, compared with 1,993 metric tons (66 percent WO_3) in 1945 and 1,989 tons (67 percent WO_3) in 1944.

French Morocco.[5]—The only known deposit of tungsten ore in French Morocco is the El Zguit, near Oulmes, east of Casablanca. The ore, which was not discovered until after World War II had begun, occurs as wolframite, ferberite, and scheelite along the margins of a few large quartz veins. The only production from the deposit has been accessory to exploratory trenching. Most of the work has been done on two veins, and mineralization has been found over a length of possibly 2 miles. The owner reports that crushing and washing yield a concentrate containing 65 percent WO_3.

Japan.[6]—The tungsten industry of Japan was negligible prior to 1934; Japanese industry demanded less than 100 metric tons of concentrates annually, a need supplied by a few mines in Japan and small imports from Korea. After 1934 the demand for tungsten concentrates increased, and exploration of domestic deposits was stimulated by high prices, Government subsidies, and priorities for labor and supplies. As a result, domestic production increased to a peak of 817 metric tons (60 percent WO_3 basis) in 1942 and totaled 4,478 tons from 1935 to 1945. This domestic output furnished about one-tenth of the concentrates consumed by the war-expanded industrial plants of Japan Proper. Almost three-fifths was supplied by imports from Korea, and about three-tenths from other countries. About 95 percent of all concentrates produced and imported by Japan was consumed in the production of ferrotungsten; the remainder was used in the manufacture of tungsten powder. Plants in Japan Proper produced 19,500 metric tons of ferrotungsten between 1934 and 1945. Estimated reserves of tungsten ore are small and of low grade. Future production of tungsten probably will be insufficient to meet requirements of industry.

The accompanying table shows world production of tungsten by countries from 1939 to 1946, insofar as statistics are available.

[5] Heck, E. T., Tin and Tungsten Deposits of French Morocco: Econ. Geol., vol. 41, pt. 4, June–July 1946, pp. 383–389.

[6] General Headquarters Supreme Commander for the Allied Powers, Natural Resources Section, Tungsten Resources of Japan: Rept. 77, Apr. 29, 1947, 29 pp.

World production of tungsten ores, 1939–46, by countries, in metric tons of concentrates containing 60 percent WO_3 [1]

[Compiled by B. B. Mitchell]

Country [1]	1939	1940	1941	1942	1943	1944	1945	1946
North America:								
Canada	4	6	32	244	618	214	-------	-------
Cuba (exports)	-------	(2)	(2)	7	7	-------	9	-------
Mexico	229	216	191	193	516	336	134	95
United States (shipments)	3,889	4,825	5,957	8,467	10,836	9,329	5,020	4,711
	4,122	5,047	6,180	8,911	11,977	9,879	5,163	4,806
South America:								
Argentina	1,309	1,417	1,720	2,115	2,390	2,043	500	(2)
Bolivia (exports)	3,337	4,183	4,353	5,606	6,902	7,935	3,851	2,120
Brazil (exports)	7	9	35	9	1,264	2,221	2,192	1,623
Chile	-------	-------	1	-------	3	3	(2)	(2)
Peru	170	290	337	510	722	635	523	510
	4,823	5,899	6,446	8,240	11,281	12,837	(2)	(2)
Europe:								
France	284	138	120	95	126	84	(2)	(2)
Great Britain: Cornwall	188	201	127	198	237	350	77	(2)
Italy	2	2	1	(2)	(2)	(2)	(2)	(2)
Norway	31	10	8	7	-------	4	(2)	(2)
Portugal	3,851	4,858	5,834	5,220	7,477	4,088	-------	630
Spain	368	393	415	1,462	3,902	2,393	283	363
Sweden	158	145	228	267	290	335	413	(2)
	4,882	5,747	6,733	(2)	(2)	(2)	(2)	(2)
Asia:								
Burma	8,238	(2)	(2)	(2)	(2)	(2)	(2)	(2)
China	12,871	10,141	13,538	12,962	9,734	3,502	2,929	2,691
India	(2)	44	77	87	85	33	22	(2)
Indochina: Tonkin	507	390	333	213	107	83	8	(2)
Japan [3]	299	479	601	817	733	575	193	59
Korea (Chosen)	3,969	4,525	4,650	6,062	6,932	8,402	(2)	[4] 313
Malay States:								
Federated	246	108	[5] 53	[6] 42	[6] 88	[6] 136	[6] 13	[6] 10
Unfederated	362	427	(2)	(2)	(2)	(2)	(2)	
Netherlands Indies	2	(7)	(2)	-------	-------	-------	(2)	(2)
Siam (Thailand)	378	400	(2)	(2)	(2)	(2)	(2)	(2)
	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Africa:								
Belgian Congo	-------	63	123	315	467	433	513	397
Egypt	-------	15	43	17	42	16	-------	-------
Morocco, French	4	-------	-------	(7)	-------	3	(2)	(2)
Nigeria	237	131	-------	[8] 69	75	30	6	(2)
Southern Rhodesia	270	246	264	504	806	757	287	53
South-West Africa	50	24	116	122	174	118	4	-------
Tanganyika (exports)	(7)	2	1	2	3	-------	(2)	(2)
Uganda	2	(2)	-------	7	33	95	92	(2)
Union of South Africa	100	105	142	400	430	660	452	715
	663	(2)	689	1,436	2,030	2,112	(2)	(2)
Oceania:								
Australia:								
New South Wales	117	76	95	52	75	53	53	(2)
Northern Territory	342	314	333	159	193	102	140	74
Queensland	93	129	137	217	177	229	155	75
Tasmania	477	607	577	475	463	300	800	850
New Zealand	49	88	79	73	121	159	37	30
	1,078	1,214	1,221	976	1,029	843	1,185	(2)
Total (estimate)	42,500	44,000	52,000	51,000	61,000	49,000	23,000	19,000

[1] In addition to countries listed, tungsten ore is produced in U. S. S. R. and Western Australia, but data on production are not available.
[2] Data not available.
[3] Preliminary data for the fiscal year ended March 31 of the year following that stated.
[4] South Korea only.
[5] January to September, inclusive.
[6] Estimate.
[7] Less than 1 ton.
[8] Exports.

Uranium and Thorium [1]

By ALLAN F. MATTHEWS

	PAGE
General summary	1205
Domestic production	1207
Mine production	1207
Production of source metals	1208
Production of fissionable metals	1209
Reserves	1211
Government regulations	1212
Consumption and uses	1217
Weapons	1217
Consumption and uses—Cont.	
Industrial power	1218
Radioisotopes	1221
Nonenergy uses	1222
Stocks	1223
Prices	1223
Foreign trade	1224
Technology	1226
World review	1226

GENERAL SUMMARY

COGNIZANCE of the military and industrial power derivable from nuclear energy prompted an intensive global hunt in 1946 for uranium and thorium ores. Quantities found, mined, exported, or refined were kept secret by all nations for security reasons, and thus no measure of current or potential supply is obtainable. Before World War II the most productive uranium-radium mines were in Belgian Congo and Canada; there were other important mines in the United States, Czechoslovakia, Portugal, and possibly Russia. The principal thorium-cerium mines were in India and Brazil. The status of the United States as the only country with facilities for manufacturing atomic bombs probably was maintained in 1946, but chain-reacting piles for producing fissionable metals were under construction in the United Kingdom and Canada. Strict national controls on the production and transfer of uranium and thorium and on the dissemination of information on nucleonics were enacted by more than a dozen major countries in the closing months of 1945 and in 1946. International safeguards were discussed by the United Nations Atomic Energy Commission during the latter half of the year. Espionage activities were exemplified by Soviet efforts, described in a Canadian court report,[2] to procure secret American-British nucleonics data and samples of enriched uranium isotopes.

Nuclear work in the United States was administered from August 1942 (more comprehensively from the spring of 1943) to the end of

[1] In preceding issues of Minerals Yearbook uranium was discussed in the Radium and Uranium section of the Minor Metals chapter, and thorium was treated in the Monazite section of the Minor Nonmetals chapter.

This chapter in its entirety (except for data on consumption of uranium for nonenergy purposes) is a summary of information that has heretofore been published.

[2] Royal Commission To Investigate the Facts Relating To and the Circumstances Surrounding the Communication by Public Officials and Other Persons in Positions of Trust of Secret and Confidential Information to Agents of a Foreign Power, Report: Ottawa, 1946, 733 pp.

1946 by the Manhattan District, Corps of Engineers, Army Service Forces. A record of its activities was published in the Smyth report.[3] Numerous bills for the control of atomic energy were introduced in the Congress in September 1945 and subsequent months, but none became law for nearly a year. The delay "has meant, unfortunately," stated [4] Maj. Gen. Leslie R. Groves, officer in charge of the Manhattan District, "that we have had to make decisions that will commit that commission (which Congress will establish) for years to come. Some of them probably for as much as 5, 10 or 15 years." The Atomic Energy Act was approved August 1, 1946. It provided for establishment of a civilian Atomic Energy Commission that took over Manhattan District facilities, functions, and personnel December 31. At that time there were working on the project more than 5,000 direct employees—military and civilian—plus more than 50,000 employees of contractors operating Government installations.

Funds appropriated by Congress for the atomic bomb project totaled almost 2 billion dollars by the middle of 1945. In 1946 the War Department transferred to the Atomic Energy Commission $506,000,000, of which $263,991,000 was immediately allocated to cover contracts and other obligations and $5,000,000 was assigned to the Federal Bureau of Investigation. The President's budget for the fiscal year beginning July 1, 1947, included $250,000,000 for Commission expenditures and a like amount for Commission contract authorizations.

The U. S. Geological Survey continued in 1946 its services for the Atomic Energy Commission.

In the present state of world affairs, the most important use of uranium would seem to be in making atomic bombs. Two were detonated at Bikini, Marshall Islands, in July 1946 to assay their effect on naval ships. Research on the propulsion of ships and aircraft by nuclear energy was under way during the year. Development of atomic energy for industrial purposes began to receive greater emphasis, but the consensus was that actual commercial application, probably for generation of electricity, was at least 5 years distant. Even the industrial developments are significant from a security point of view, as stressed by Rear Adm. William S. Parsons, director of atomic defense for the United States Navy:

> That point is the strengthening of the Nation's over-all war potential through the development of all the peacetime constructive uses of atomic energy. For example—our automobile industry is a peacetime industry—and grew up in peacetime—but it was a most vital part of our total war potential. Atomic energy, through medical and other research advances, and through development of power, which is industrial energy, may be as important to war because of its peacetime applications as it appears to be because of its purely military applications.

Valuable byproducts of the production of fissionable metals are radioactive isotopes useful in radiation therapy (particularly radioiodine and radiophosphorus) and in tracing biological and industrial chemical reactions (particularly radiocarbon). The Manhattan District began deliveries of radioisotopes to private institutions in August 1946.

[3] Smyth, H. D., A General Account of the Development of Methods of Using Atomic Energy for Military Purposes Under the Auspices of the United States Government, 1940–1945: Washington, 1945, 182 pp.

[4] Marder, Murrey, Rotarians Told Lack of Laws Forced Army to Act on Atoms: Washington Post, Apr. 30, 1946, p. 6.

Consumption of uranium for nonenergy purposes in the United States in 1946 was only 2 tons—about the same as in 1945. Chemical reagents and special glasses were the major uses. A small quantity of thorium went into gas mantles and refractories.

There were no standard prices on uranium in 1946, but one buyer of concentrates stated in May 1947 that it would pay for the vanadium content and 35 cents to $1.10 per pound for contained U_3O_8, depending on a concentration ranging upward from 0.2 percent. One group of scientists assumed in 1946 that refined uranium metal was worth about $10 a pound and plutonium metal $20 a gram.

DOMESTIC PRODUCTION

Uranium and thorium production may be considered at a number of stages such as ore, source metal, and fissionable metal.

MINE PRODUCTION

Carnotite Ore.—Deposits of carnotite, a radium-bearing potassium-uranium vanadate, are widely distributed in western Colorado and eastern Utah, and some occur in northern Arizona.[5] These ores were mined primarily for radium until 1922, when a lull was induced by competition from Congo radium. Production was stimulated in 1935–41, principally for vanadium. Carnotite-ore shipments up to the beginning of World War II totaled several hundred thousand tons, but the demand for uranium was so small that only about 13,000 tons were classed as uranium ore. Shipments of carnotite during the latest decade for which data are available, as compiled by the Bureau of Mines, are shown in the accompanying table. It will be noted that ore and concentrates shipped during that period contained 1 to 2 percent U. It is not known how much of this uranium was recovered or how much was discarded in dumps amenable to subsequent retreatment. It is public knowledge, however, that several plants were erected in the early 1940's to treat for uranium the tailings from past and current vanadium operations.

Carnotite ore and concentrates shipped from mines in the United States, 1932–41 [1]

Year	Short tons	Value	Content		
			Uranium (pounds)	Radium (milligrams)	Vanadium (pounds)
1932	61	$6,150	3,186	481	3,024
1933	52	3,099	1,694	256	2,240
1934	254	11,074	6,661	1,007	12,528
1935	1,145	56,223	22,009	3,329	50,776
1936	1,439	73,881	17,961	2,716	52,695
1937	1,708	65,294	20,764	3,141	73,788
1938	4,290	158,779	51,705	7,821	173,859
1939	6,256	174,660	59,269	8,964	206,509
1940 [2]	796	61,800	16,909	[3] 2,557	51,377
1941 [2]	908	[4] 70,500	[3] 19,288	[3] 2,916	50,824

[1] Data for 1942–46 not available for publication.
[2] Excludes ore sold only for its vanadium value.
[3] Estimated on the basis of uranium content in 1940.
[4] Estimated on the basis of value in 1940.

[5] Huleatt, W. P., Hazen, Scott W., Jr., and Traver, William M., Jr., Exploration of Vanadium Region of Western Colorado and Eastern Utah: Bureau of Mines Rept. of Investigations 3930, 1946, 30 pp.

Uraninite Ore.—Some 150 tons of ore containing uraninite (pitchblende), an oxide of uranium, have been produced in Colorado, principally in Gilpin County before 1900. Uraninite specimens have been obtained for mineral collections from pegmatite dikes in New Hampshire, Connecticut, North Carolina, South Dakota, and other States.

Thorium Ore.—Between 1887 and 1917 the United States produced 5,456 short tons of monazite concentrates from sands and gravels in North Carolina, South Carolina, Florida, and Idaho.[6] There was little or no domestic production between World Wars I and II. Monazite is a phosphate of rare-earth metals (cerium, lanthanum, praseodymium, etc.) and contains from less than 1 percent to 18 percent thorium. Commercial monazite concentrates generally contain 6 to 8 percent thorium dioxide.

PRODUCTION OF SOURCE METALS

Source metals are those metals from which fissionable metals are derived. An account abstracted largely from the Smyth report follows.

Uranium Metal.—At the end of 1941, when the Office of Scientific Research and Development was investigating raw-material procurement as a prelude to broadening research toward an atomic bomb, the only uranium metal in existence in the United States was a few grams of pure material made on an experimental basis by the Westinghouse Electric Corp., East Pittsburgh, Pa., and by others and a few pounds of impure pyrophoric powder made by Metal Hydrides, Inc., Beverly, Mass. Westinghouse received its first Government order for uranium metal—10 kilograms—in December 1941. The quantity was supplied, for the most part, in a wide variety of shapes and sizes for the use of physicists making measurements for the plutonium piles. Articles varied from spirals of square wire to cast spheres with pipes through the center.[7]

As a step toward increasing the supply of uranium, the OSRD in May 1942 completed arrangements with Mallinckrodt Chemical Works, St. Louis, Mo., to put an improved grade of Canadian oxide through an ether-extraction process to yield a purified brown uranium dioxide. Deliveries were begun in July 1942 at a rate of 30 tons a month. At about this time the problem of uranium procurement was assumed by the Manhattan District.

The small-scale production of uranium metal at the Westinghouse laboratory in early 1942 was by electrolysis of potassium-uranium pentafluoride. That salt was later replaced by uranium tetrafluoride, production of which was begun in August 1942 by Harshaw Chemical Co., Cleveland, Ohio, and by E. I. du Pont de Nemours & Co., Inc., Penns Grove, N. J. By October 1942 production of tetrafluoride was up to 700 pounds per day by the Harshaw firm and to 300 pounds per day by the Du Pont company. As a result of this supply of raw material and also of plant expansion, production of uranium metal by Westinghouse had totaled more than 6,000 pounds by November 1942 and reached a rate of 500 pounds per day by January 1943.

Production of metal of suitable purity by Metal Hydrides, delayed by various circumstances, was begun in November 1942 and was

[6] Houk, Lawrence, G., Monazite Sand: Bureau of Mines Inf. Circ. 7233, 1943 (revised 1946), 19 pp.
[7] Chemical and Engineering News, Lamp Filament to Atomic Pile: Vol. 25, No. 4, Jan. 27, 1947, p. 236.

expected to reach 1,000 pounds per week thereafter. To exploit a new process developed by Iowa State College and the National Bureau of Standards, production facilities were set up at Ames, Iowa, in the fall of 1942; more than 1 ton of metal had been produced by the end of November of that year.

Thus almost no uranium metal was available during most of 1942, a fact that seriously delayed the progress of atomic investigations. However, the production problems had been nearly solved by the end of 1942, and 12,400 pounds of metal—the total quantity obtainable—were incorporated in the first self-sustaining chain-reacting pile, built in November 1942 at the University of Chicago. By December arrangements had been made by the Manhattan District to increase metal production by making greater use of the facilities of Mallinckrodt Chemical Works, the Union Carbide & Carbon Corp., and the Du Pont company. Further research had indicated additional process changes that could be made to advantage, and by the middle of 1943 Iowa State College and other producers were using the final production method adopted. No further serious delays or difficulties occurred because of uranium metal shortages.

Thorium Metal.—Early in the atomic investigations it was decided that uranium rather than thorium would be the source metal from which physicists would attempt to derive usable quantities of fissionable metals. Thus it appears that there was established no program, similar to that of uranium, for raising the laboratory-scale production of thorium metal to a sizable industrial level.

PRODUCTION OF FISSIONABLE METALS

Substances that consist purely of atoms that can be split artificially to release atomic energy are defined as fissionable materials. Only those that undergo fission with slow neutrons, however, are at this time important as nuclear fuels—namely, uranium–235, plutonium–239, and uranium–233.

Uranium and plutonium differ from each other in physical and chemical properties for the same reason that any other two metals are dissimilar; that is, the atoms of which they are composed simply have unlike numbers of protons (plus-charged particles) and of electrons (minus-charged particles). Uranium atoms each have 92 protons and 92 electrons, and plutonium atoms each have 94 protons and 94 electrons. As might be supposed, any atom has the same number of protons as electrons.

ISOTOPES OF URANIUM

Natural uranium consists of 99.3 percent U–238, 0.7 percent U–235, and 0.006 percent U–234. Thorium can be converted to U–233. These varieties (isotopes) of uranium are identical in chemical properties but differ pronouncedly in fissionability and to some extent in unit weight. It is, in fact, the weight to which the numerical designation of each isotope refers. The electrons that swing in orbits around the nucleus of an atom have comparatively no weight, so the weight of an atom is expressed by the sum of the neutrons (uncharged particles) and protons in its nucleus. Thus U–238 has 92 protons and

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146 neutrons (totaling 238), and U–235 has 92 protons and 143 neutrons (totaling 235).

The production of pure U–235, one of the three nuclear fuels, involves the treatment of refined natural uranium metal to separate out the 1 part in 140 that is U–235. Separation has been achieved by four methods: (1) Gaseous diffusion, (2) electromagnetism, (3) thermal diffusion, and (4) centrifugation.

U–235 by Gaseous Diffusion.—It had been demonstrated before the end of 1941 that the isotopes of uranium could be separated by passing gaseous uranium hexafluoride through a series of porous barriers, such as acid-etched silver-zinc alloy. Plans for the first large-scale plant were begun by Kellex Corp., Jersey City, N. J., subsidiary of the M. W. Kellogg Co., early in 1942 with the objective of an enrichment 10 times greater than in natural uranium; several thousand process stages were to be required. Construction of various major units was commenced between June and September 1943 at the Clinton Engineer Works, Oak Ridge, Tenn., and the gaseous diffusion plant was in successful operation by the Carbide & Carbon Chemical Corp., subsidiary of Union Carbide & Carbon Corp., before the summer of 1945. The plant cost $545,000,000.

U–235 by Electromagnetic Separation.—Construction of the first large-scale plant for electromagnetic separation of uranium isotopes was begun at the Clinton Engineer Works, Oak Ridge, Tenn., in March 1943, and initial units were completed by the fall of the year. Total cost of construction was $350,000,000. The Tennessee Eastman Corp., subsidiary of Eastman Kodak Co., assumed responsibility of operation. In the winter of 1944–45 the electromagnetic plant achieved large-scale production of U–235 of sufficient purity for use in atomic bombs and was thus the earliest source of appreciable quantities of the prized uranium isotope.

U–235 by Thermal Diffusion.—A pilot plant for the separation of isotopes by thermal diffusion in a liquid compound of uranium had been built by the spring of 1943 at the Naval Research Laboratory, Washington, D. C., and another a little later at the Philadelphia Navy Yard, Philadelphia, Pa. The success of those units led in the late summer of 1944 to erection of a large-scale plant, costing $10,500,000, at Oak Ridge in order to provide enriched feed material for increasing considerably the production rate of the electromagnetic plant. That purpose was achieved; but a number of disappointments were encountered, and the future of the thermal-diffusion plant was stated officially in 1945 to be uncertain.

U–235 by Centrifugation.—Standard Oil Development Co., Bayway, N. J., successfully operated a pilot plant for centrifugal enrichment of uranium isotopes and obtained approximately the same degree of separation as predicted by theory. The pilot plant was later shut down, and no large-scale plant was authorized.

Uranium–233.—It is known that U–233, obtained by transmutation of thorium, undergoes fission with slow neutrons and is thus a potential nuclear fuel.

PLUTONIUM

Besides U–235, plutonium (Pu–239) also is fissionable and thus releases atomic energy. It too is derived from natural uranium

metal; but, unlike U–235, plutonium is a different element and can therefore be extracted by chemical means rather than by the laborious physical processes just outlined for separating the isotope. Only minute quantities of plutonium are contained in natural uranium, but pure uranium metal embedded in a large graphite pile can be transmuted into plutonium. In such a pile the neutrons spontaneously emitted by the 0.7 percent of U–235 present in the uranium metal are slowed down in speed by the graphite moderator to a specific velocity that permits them to penetrate the nuclei of uranium atoms with two beneficial results: (1) Those neutrons that penetrate atoms of U–235 cause fission with release of energy and with emanation of additional neutrons that keep the pile operating automatically through a chain reaction; (2) those neutrons that penetrate atoms of common U–238 convert the nonfissionable uranium to fissionable plutonium.

Plutonium was discovered toward the close of 1940 and by the end of 1942 something over 500 micrograms in the form of pure salts had been produced in cyclotrons at the University of California, Berkeley, Calif., and Washington University, St. Louis, Mo. The first self-sustaining chain-reacting pile began operation in the Metallurgical Laboratory, University of Chicago, Chicago, Ill., December 2, 1942, and reached a power level of 0.2 kilowatt December 12. The following month a decision was made to build a plutonium production plant of large capacity. It was clear that a rate of output somewhere between 1 kilogram (2.2 pounds) of plutonium a month and 1 kilogram a day would be required, and that the latter rate would necessitate a plant of 500,000 to 1,500,000 kilowatts. E. I. du Pont de Nemours & Co., Inc., designed and constructed at the Clinton Engineer Works, Oak Ridge, Tenn., a $12,000,000 semiworks operated by the University of Chicago Metallurgical Laboratory. The plant began operation November 4, 1943; by the end of January 1944 metal from the pile was going to the separation plant at the rate of one-third ton per day, and 190 milligrams of plutonium had been produced. The output of plutonium the following month was several grams. Although planned at 1,000 kilowatts, a power level of 1,800 kilowatts was attained in May 1944. The pile was air-cooled and thus differed from subsequent piles that were water-cooled, so only the chemical separation unit could be considered a pilot plant. Construction of the first large-scale plutonium-production plant was begun at the Hanford Engineer Works, Pasco, Wash., June 7, 1943. Of three Hanford piles, the first was put into operation September 26, 1944, and the second and third in the fall of 1944 and early months of 1945. The plant, costing $350,000,000, was designed by the Du Pont company and was operated by it until September 1, 1946, when the General Electric Co. assumed operation. An experimental pile was built at the Manhattan District $60,000,000 laboratory at Los Alamos, N. Mex., some time after the spring of 1943.

RESERVES

The Smyth report states: "Early rough estimates, which are probably optimistic, were that the nuclear energy available in known deposits of uranium was adequate to supply the total power needs of this country for 200 years (assuming utilization of U–238 as well as

U-235)." It pointed out later, however, with reference to uranium in unspecified form, that "the total available supply is seriously limited."

Igneous rocks average 0.008 percent uranium and 0.002 percent thorium, according to one study,[8] and the earth's crust averages 0.0004 percent uranium and 0.0011 percent thorium, according to another.[9] It would thus appear that uranium and thorium are more plentiful than gold, silver, bismuth, mercury, and boron and nearly as abundant as lead, zinc, and tin. Such comparisons, however, have little meaning from the point of view of availability. The more important consideration is what quantity of a given metal has been concentrated by geological processes into accessible bodies so as to form ore deposits. As regards uranium and thorium, the minimum concentration of any interest at present is 0.05 percent, judging from Atomic Energy Commission license regulations.

Plutonium (element 94, nuclear fuel derived by transmutation of uranium) occurs in pitchblende to the extent of only 1 part in 10^{14} and in carnotite at about the same concentration. Thus it is not likely that transuranium elements exist in practical quantities on the surface of the earth.[10]

GOVERNMENT REGULATIONS

As early as 1939 scientists began voluntarily to withhold from publication papers concerning nuclear fission. The policy was systemized in the spring of 1940 by the establishment in the National Research Council of a Reference Committee, to which the editors of scientific journals sent papers on the subject in cases where the advisability of publication was in doubt. All personnel of the Manhattan District were required to regard information about their work as secret, in accordance with provisions of the Wartime Espionage Act.

Government control of uranium was initiated through War Production Board Conservation Order M-285, effective January 26, 1943, which restricted the use of uranium in ceramics and photography. The order was amended March 1, 1945, to place uranium under allocation (beginning retroactively September 1, 1944) and to require reporting of stocks of uranium in any form, including ore and tailings. No corresponding order for thorium was promulgated during the war.

Subject to existing rights, all public lands of the United States containing deposits of radioactive minerals were withdrawn from disposal and reserved for the use of the United States, according to President Truman's Executive Order 9613 of September 13, 1945. That order was revoked March 4, 1946, and superseded by Executive Order 9701, which reserved fissionable materials (instead of radioactive minerals) to the Federal Government.

Although President Truman had recommended legislation on atomic energy August 6 and—in a more comprehensive message—October 3, 1945, it was not until August 1, 1946, that the first congressional act

[8] Clarke, Frank Wigglesworth, and Washington, Henry Stephens, The Composition of the Earth's Crust: Geol. Survey Prof. Paper 127, 1924, pp. 20-24.

[9] Goldschmidt, V. M., The Principles of Distribution of Chemical Elements in Minerals and Rocks: Jour. Chem. Soc. (London), April 1937, p. 656.

[10] Chemical and Engineering News, Seaborg Discusses Transuranium Elements in Howe Lecture: Vol. 24, No. 23, Dec. 10, 1946, pp. 3160-3161.

on the subject—the Atomic Energy Act of 1946 (Public Law 585, 79th Congress)—was approved. The act provided for the establishment of an Atomic Energy Commission with very broad powers of control over both the military and industrial production and utilization of atomic energy. An abstract, largely paraphrased, of the act follows:

Section 1. Declaration of Policy.—It is hereby declared to be the policy of the people of the United States that, subject at all times to the paramount objective of assuring the common defense and security, the development and utilization of atomic energy shall, so far as practicable, be directed toward improving the public welfare, increasing the standard of living, strengthening free competition in private enterprise, and promoting world peace.

Section 2. Organization.—An Atomic Energy Commission of five members, including a Chairman, shall be appointed by the President with the consent of the Senate. The term of office shall be five years, except that the first term will expire August 1, 1948, and the second one will be from one to five years so as to stagger future appointments. There are established within the Commission a General Manager and separate Divisions of Research, Production, Engineering, and Military Application. The annual salary of the Chairman is to be $17,500, other members and the General Manager $15,000, and division Directors $14,000. The Commission shall be advised by a General Advisory Committee of nine members, appointed by the President, and by a Military Liaison Committee detailed by the Secretaries of War and Navy in such number as they may determine.

Section 3. Research.—The Commission is authorized to conduct research in its own facilities and to contract with public or private institutions or persons for research on the theoretical and practical aspects of nuclear processes, atomic energy, protection of health, and the utilization of fissionable and radioactive materials for medical, biological, health, military, and industrial purposes.

Section 4. Production of Fissionable Material.—The Commission shall be the exclusive owner of all facilities for the production of fissionable material other than research and development facilities whose potential production rate is insufficient to produce an atomic weapon. The Commission is authorized to produce fissionable materials in quantities determined by the President, and it may let contracts for operation of its facilities. No person may manufacture, transfer, or acquire facilities for the production of fissionable material except by license from the Commission.

Section 5 (a). Control of Fissionable Materials.—As used in this Act, the term "fissionable material" means plutonium, uranium enriched in the isotope 235, any other material which the Commission determines to be capable of releasing substantial quantities of energy through nuclear chain reaction of the material, or any material artificially enriched by any of the foregoing; but does not include source material. It shall be unlawful for any person after September 30, 1946, to possess or transfer any fissionable material, except as authorized by the Commission. The Commission shall be the exclusive owner of all fissionable material within the jurisdiction of the United States, but it is directed to distribute sufficient fissionable material owned by it to permit widespread independent research and development, to the maximum extent practicable. No applicant shall be distributed a quantity of fissionable material sufficient to construct a military weapon.

Section 5 (b) (1–5). Control of Source Materials.—As used in this Act, the term "source material" means uranium, thorium, or any other material which is determined by the Commission, with the approval of the President, to be peculiarly essential to the production of fissionable materials; but includes ores only if they contain one or more of the foregoing materials in such concentration as the Commission may by regulation determine from time to time. Unless authorized by a license issued by the Commission, no person may deliver or receive any source material after removal from its place of deposit in nature, except that licenses shall not be required for quantities of source materials which, in the opinion of the Commission, are unimportant. The Commission is directed to acquire supplies of source materials and interest in property containing deposits of source materials to the extent it deems necessary to effectuate the provisions of this Act.

Section 5 (b) (6). Exploration for Source Materials.—The Commission is authorized to conduct and enter into contracts for the conduct of exploratory operations, investigations, and inspections to determine the location, extent, mode of occurrence, use, or conditions of deposits or supplies of source materials, making

just compensation for any damage or injury occasioned thereby. Such exploratory operations may be conducted only with the consent of the owner, but such investigations and inspections may be conducted with or without such consent.

Section 5 (b) (7). Source Materials on Public Lands.—All uranium, thorium, and other materials peculiarly essential to the production of fissionable material, contained, in whatever concentration, in deposits in the public lands are hereby reserved for the use of the United States subject to valid claims existing on August 1, 1946. No individual who had any part in the development of the atomic bomb project may benefit by a location made upon the public domain after August 1, 1946, that was a result of acquisition of confidential official information regarding the existence of source materials in the lands upon which such location is made. Any patented lands on the public domain may be worked, but when such use results in the extraction of any source material in quantities which may not be transferred without a license, such material shall be the property of the Commission and the Commission may require delivery of such material to it by any possessor thereof after such material has been separated from the ores in which it was contained. If the Commission requires the delivery of such material to it, it shall pay to the person mining or extracting the same, or to such other person as the Commission determines to be entitled thereto, such sums, including profits, as the Commission deems fair and reasonable for the discovery, mining, development, production, extraction, and other services performed, but such payment shall not include any amount on account of the value of such material before removal from its place of deposit in nature.

Section 5 (c). Control of Byproduct Materials.—As used in this Act, the term "byproduct material" means any radioactive material (except fissionable material) yielded in or made radioactive by exposure to radiation incident to the processes of producing or utilizing fissionable material. The Commission is authorized to distribute byproduct materials and shall give preference to applicants proposing to use such materials in the conduct of research and development activity or medical therapy. The Commission shall recall any materials used in a manner other than as disclosed in the application therefor.

Section 5 (d). General Provisions for Control of Materials.—The Commission shall not distribute fissionable material to any foreign government or to any person for a use which is not within the jurisdiction of the United States.

Section 6. Military Applications.—The Commission is authorized to develop and produce atomic weapons but only to an extent directed by the President. The President from time to time may direct the Commission (1) to deliver fissionable materials or weapons to the armed forces and (2) to authorize the armed forces to manufacture equipment utilizing fissionable material as a weapon.

Section 7. Utilization of Atomic Energy.—It shall be unlawful, except as provided in sections 5 (a) and 6, for any person to manufacture, use, or export any equipment utilizing fissionable material or atomic energy except under a license from the Commission. Nothing in this section shall be deemed to require a license for the conduct of research or development activities relating to the manufacture of such equipment or the utilization of fissionable material or atomic energy, or for the manufacture or use of equipment for medical therapy.

Section 8. International Arrangements.—Any provision of this Act or any action of the Commission to the extent that it conflicts with the provisions of any international arrangement made after August 1, 1946, shall be deemed to be of no further force or effect.

Section 9. Property of the Commission.—The President shall direct the transfer to the Commission of all interests owned by the United States in fissionable material, atomic weapons, facilities and materials for producing and utilizing fissionable material and atomic energy, technical information, patents, inventions, and discoveries related thereto.

Section 10. Control of Information.—It shall be the policy of the Commission to control the dissemination of restricted data in such a manner as to assure the common defense and security. Until Congress declares that effective international safeguards against the use of atomic energy for destructive purposes have been established, there shall be no exchange of information with other nations with respect to the use of atomic energy for industrial purposes. The dissemination of scientific and technical information relating to atomic energy should be permitted and encouraged so as to provide that free interchange of ideas and criticisms which is essential to scientific progress. Whoever discloses, or attempts to acquire with intent of disclosure, any restricted data concerning the production or utilization of fissionable material, atomic weapons or atomic power, or whoever

conceals, alters, or destroys such restricted data, with intent to injure the United States or to secure an advantage to a foreign nation, upon conviction thereof, shall be punished by death or by imprisonment for life; or by a fine of not more than $20,000 or imprisonment for not more than twenty years, or both.

Section 11. Patents and Inventions.—Any person who makes an invention or discovery useful in producing or utilizing fissionable material or atomic weapons shall file with the Commission a complete description thereof. No patent shall be granted on the production of fissionable materials or atomic weapons. Patents may be granted on the utilization of atomic energy, but the Commission may requisition or condemn such patents, making just compensation therefor.

Sections 12–21.—The last ten sections are titled General Authority, Compensation for Property Acquired, Judicial Review and Administrative Procedure, Joint Committee on Atomic Energy, Enforcement, Reports, Definitions, Appropriations, Separability of Provisions, and Short Title. Section 17 on Reports directs the Commission to submit to Congress in January and July of each year a report concerning its activities.

After passage of the act, section 15 was implemented by organization of a Congressional Joint Committee on Atomic Energy, which elected Senator Brien McMahon chairman for the remainder of the Seventy-ninth Congress, second session.

Members of the Atomic Energy Commission were appointed by President Truman October 28, 1946, and held their first formal meeting November 13 at Oak Ridge, Tenn. Other presidential appointees were the General Advisory Committee, December 12, and the General Manager, December 30. The Military Liaison Committee was named by the Secretaries of War and Navy November 4. Properties, functions, and—in large part—personnel of the Manhattan District were transferred to the Atomic Energy Commission in accordance with Executive Order 9816, effective January 1, 1947. At that time the organization of the Commission was as follows:

Members:
- David E. Lilienthal, Chairman
- Robert F. Bacher
- Sumner T. Pike
- Lewis L. Strauss
- William W. Waymack

General Advisory Committee:
- J. Robert Oppenheimer, Chairman
- James B. Conant
- Lee A. DuBridge
- Enrico Fermi
- Isidor I. Rabi
- Hartley Rowe
- Glenn T. Seaborg
- Cyril S. Smith
- Hood Worthington

General Manager: Carroll L. Wilson
Director, Division of Research: James B. Fisk
Director, Division of Production: Walter J. Williams
Director of Organization and Personnel: G. Lyle Belsley
General Counsel: Herbert S. Marks
Military Liaison Committee:
- Lt. Gen. Lewis H. Brereton, Chairman
- Maj. Gen. Lunsford E. Oliver
- Col. John H. Hinds
- Rear Adm. Thorvald A. Solberg
- Rear Adm. Ralph A. Ofstie
- Rear Adm. William S. Parsons

The Senate Committee on Atomic Energy began hearings January 27, 1947, on the appointments of the members and General Manager

of the Commission. After considerable testimony, particularly with respect to the proposed chairman, the appointees were confirmed by the Senate April 9, 1947.

Conservation Order M–285, previously mentioned, was administered by the Civilian Production Administration during most of 1946 and by the Office of Temporary Controls, its successor, from December 12,1946, to March 31, 1947, when the order lapsed and was superseded by Atomic Energy Commission Control of Source Material Part 40 (Code of Federal Regulations Title 11).

The new regulation provided that on and after April 1, 1947, no person, unless licensed by the Atomic Energy Commission, may transfer, deliver, receive possession of or title to, or export any source material, after removal from its place of deposit in nature, containing as much as 0.05 percent uranium or thorium in any proportion. The restrictions were stated not to apply to transfers or deliveries in any one month of source material containing less than 10 pounds of uranium or thorium. Nor do they apply to incandescent mantles, ceramic products, refractories, glass products, and vacuum tubes; to photographic film, negatives, and prints; or to rare-earth metal, compounds, mixtures, and products containing not more than 0.25 percent Th or U. All stocks of raw source material that have been removed from their place of deposit in nature and contain 10 pounds or more U or Th and all stocks of refined source material that contain 1 pound or more U or Th must be reported to the United States Atomic Energy Commission, P. O. Box 42, Station F, New York 16, N. Y., where applications for licenses are handled.

International Control.—The United Nations organization came into official existence October 24, 1945. A proposal to set up within that organization a commission to prepare recommendations on atomic energy was made by President Truman, Prime Minister Attlee of the United Kingdom, and Prime Minister King of Canada in the Three-Nation Agreed Declaration signed in Washington November 15, 1945. A comprehensive inquiry into the nature and possibilities of effective safeguards was initiated by Secretary of State Byrnes, who in January 1946 appointed a committee consisting of Under Secretary of State Dean Acheson, chairman, John J. McCloy, Vannevar Bush, James B. Conant, and Maj. Gen. Leslie R. Groves. That committee January 23 appointed a Board of Consultants, who published March 28 the Acheson-Lilienthal report,[11] not as a statement of policy but as a basis for discussing effective safeguards.

The United Nations Atomic Energy Commission was established January 24, 1946. Bernard M. Baruch was appointed United States Representative on that Commission by President Truman March 18, with Senate approval April 5. Baruch selected as associates John M. Hancock, Ferdinand Eberstadt, Fred Searls, Jr., Herbert B. Swope, Richard C. Tolman, Thomas F. Farrell, and John Parks Davis. The first meeting of the international commission was in New York City June 14, 1946. Official declarations and proposals

[11] Lilienthal, David E. (Chairman), Barnard, Chester I., Oppenheimer, J. Robert, Thomas, Charles Allen, and Winne, Harry A., A Report on the International Control of Atomic Energy: U. S. Department of State Pub. 2498, 1946, 61 pp.

relating to the international control of atomic energy were published.[12] Baruch and his principal associates resigned January 7, 1947, because they considered that their phase in the work of guaranteeing the peaceful use of atomic energy had been completed. United States representation on the international commission was then added to the duties of Warren R. Austin, United States member of the United Nations Security Council.

CONSUMPTION AND USES

Most of the uranium produced currently in the world is apparently being used in the development and production of atomic weapons and, in lesser degree, of industrial power. Radioactive elements useful in medicine, science, and industry are byproducts. There are minor chemical and ceramic uses of uranium and thorium compounds.

WEAPONS

The first atomic bomb was detonated July 16, 1945, on the Alamogordo proving ground, Los Alamos, N. Mex. The second and third were exploded August 6 and 9 (August 5 and 8, United States time), 1945, over the Japanese cities of Hiroshima and Nagasaki, respectively.[13] The fourth and fifth atomic bombs were used July 1 and 25 (June 30 and July 24, United States time), 1946, to test their effect on naval ships and auxiliary vessels at Bikini atoll, Marshall Islands.[14] A British report has been quoted[15] as stating that the minimum quantity of plutonium to be explosive is 22 to 66 pounds (10 to 30 kilograms).

Production operations by the Manhattan District and research and development work on improved atomic weapons were continued during 1946, according to the Atomic Energy Commission first semiannual report. Research was begun on the development of atomic engines for large naval ships, and there was official speculation about atomic torpedoes. The NEPA (Nuclear Energy for Propulsion of Aircraft) project was begun in July 1946 to investigate the possibility of applying nucleonics to airplanes;[16] the work is a joint effort of the Army Air Forces, National Advisory Committee on Aeronautics, the Fairchild Engine & Airplane Corp. (prime contractor), and other private companies.

[12] U. S. Department of State, The International Control of Atomic Energy—Growth of a Policy: Pub. 2702, 1946, 281 pp.
Baruch, Bernard M., Toward Effective International Atomic Energy Control: U. S. and United Nations Rept. 6, U. S. Department of State Pub. 2713, 1947, 13 pp.
United Nations Atomic Energy Commission to the Security Council, First Rept., Dec. 31, 1946: U. S. and United Nations Rept. 8, U. S. Department of State Pub. 2737, 1947, 101 pp.

[13] United States Strategic Bombing Survey, The Effects of Atomic Bombs on Hiroshima and Nagasaki: 1946, 47 pp., 2 maps.
Manhattan Engineer District, The Atomic Bombings of Hiroshima and Nagasaki:, 1946, 2 vol., 43 pp., 101 figs.
Stimson, Henry L., The Decision To Use the Atomic Bomb: Harper's Monthly, vol. 194, No. 1161, February 1947, pp. 97–107.

[14] Lippert, T. W., Fission at Bikini—Bomb by Manhattan: Iron Age, vol. 158, No. 3, July 18, 1946, pp. 50–55, 73–74.
Taylor, Robert L., Footnotes to the Bikini Bombs: Chem. Industries, vol. 59, No. 3, September 1946, pp. 476–478.

[15] Science News Letter, Two New Secrets About Atomic Bombs: Vol. 50, No. 10, Sept. 7, 1946, p. 153.

[16] Graham, Frederick, U. S. at Work on Project To Apply Atomic Power to Planes, Missiles: New York Times, Feb. 23, 1947, pp. 1, 43

INDUSTRIAL POWER

Operation of a number of chain-reacting piles between 1942 and 1946 demonstrated that the energy of the atomic nucleus had been effectively harnessed. During 1946 it was generally believed that pilot plants would be producing commercially usable nuclear power within a few years and that such power would find economic industrial application—most probably for central-station generation of electricity—in less than 10 years. By the end of 1946 there were some predictions that commercial electric power from atomic prime movers was only about 5 years away.

Compton-Jeffries Statement.—Some of the factors involved in converting atomic energy to usable power were outlined by two scientists, formerly affiliated with the Manhattan District, in a statement [17] transmitted to the United Nations Atomic Energy Commission on July 10, 1946. It was pointed out that, while there may be other possibilities, the most obvious method of producing power from atomic fission is to heat a cooling agent in the chain-reacting pile and pass the heated coolant through a heat exchanger that makes steam for driving a turbine. By using uranium containing more than the usual fraction of U–235, chain-reacting units of smaller size may be built, but there is a lower limit to size and weight imposed by the massive shield necessary to prevent emanation of dangerous radiations. For ordinary uses the weight of this shield would need to be of the order of tons. The use of atomic energy for driving automobiles or aircraft of customary size is therefore not in sight, the two scientists believed. Prominent among the advantages of atomic power are the wide flexibility and easy control of the rate at which power is developed, the insignificant weights of uranium compared with conventional fuels for equal quantities of heat energy (particularly important in areas of high transportation costs), and the production of radioactive products of sufficient value to carry a fair share of the operating cost. Unfavorable factors include the necessity, at the present stage of technological development, of an involved and expensive chemical treatment to decontaminate periodically the uranium fuel and of the maintenance of special technical crews familiar with radiological hazards.

Monsanto Study.—Under the direction of Charles A. Thomas, a technical staff of Monsanto Chemical Co., operator of the Clinton Laboratories, Oak Ridge, Tenn., prepared for transmittal to the United Nations Atomic Energy Commission on September 5, 1946, a brief report [18] on the possible costs of nuclear power. Although no such plant had ever been built or even designed, it was felt probably that a stationary nuclear power plant of 75,000 kilowatts could be built in eastern United States for approximately $25,000,000 and would deliver power at about 8 mills per kilowatt-hour. Under similar conditions a coal-power plant would cost $10,000,000 to build and 6½ mills per kilowatt-hour to operate, provided its fuel was bituminous coal (13,500 B. t. u.) at $7 per ton delivered. Equality of operating

[17] Compton, Arthur H., and Jeffries, Zay, Future of Atomic Energy: The International Control of Atomic Energy—Scientific Information Transmitted to the United Nations Atomic Energy Commission June 14–Oct. 14, 1946: U. S. and United Nations Rept. 5, U. S. Department of State Pub. 2661, 1946, pp. 81–85.

[18] Tolman, Richard C., Nuclear Power. Work cited in footnote 17, pp. 125–127.

costs between nuclear and coal plants would be reached if the coal cost $10 per ton. In each instance, it was assumed that the plant would operate at 100 percent of capacity and that the interest charges on the investment would be 3 percent. The commercial pile considered would differ from the Hanford piles in that the operating temperature would be high enough to supply power and all plutonium formed would be recovered for later consumption in a pile. It seems reasonable to expect, the report pointed out, that development of nuclear power will result in standardization of design and material reduction in investment and operating costs. The placing of small nuclear power plants at strategic points on established utility-company systems would greatly reduce power-transmission costs, make feasible greater decentralization of industry, and insure partial operation of a system if its superpower stations were inoperative. The combination of a nuclear power plant with the modern gas turbine,[19] makes unnecessary a supply of water for steam or cooling.

California Scientists' Study.—The Carnegie Endowment Committee on Atomic Energy, in cooperation with J. B. Condliffe of the University of California and with other members of the Northern California Association of Scientists, called together a group to analyze such information regarding nuclear power potentialities as was then publicly available.[20] The group, without benefit of confidential information, estimated costs and income of nuclear power stations under specified conditions, as shown in the accompanying table. It was concluded that a large primary pile probably could sell plutonium at a price equivalent thermally to coal and still produce power at a cost of 3 to 4 mills per kilowatt-hour and that stations consuming plutonium priced at $20 per gram could generate power costing 5 to 15 percent less than that from competitive plants using coal at $6 per short ton. Primary pile units must be relatively large in order to be efficient, particularly in consideration of the facilities for chemical processing and disposal of wastes. In this study a yield of only 550 pounds of plutonium from an original 10,000 pounds of uranium was assumed. An approximately equal weight of fission products would be formed, so that the over-all efficiency of uranium transmutation assumed is only about 11 percent, the remaining 89 percent going out with the wastes. The process need not be so inefficient; but even if it were, only 100 tons of pure uranium per year would be required to supply the electric power that is now used in the United States.

Westinghouse Interim Study.—Two engineers of Westinghouse Electric Corp., East Pittsburgh, Pa., concluded in the fall of 1946 that nuclear energy is likely to become commercial, that the cost will not be excessive but neither is it likely to revolutionize power costs, and that numerous large technical difficulties must be resolved—probably by years of development—before a commercial nuclear energy plant can be established.[21] The engineers estimated that a 100,000-kilowatt nuclear power plant would cost $12,000,000 to $18,000,000 compared with a coal-fueled plant costing $9,000,000. Their calculations indicate that such a nuclear plant could generate power, assuming a load

[19] See also Sawyer, R. Tom, Possible Methods of Converting Atomic Energy into Mechanical Power: Applied Atomic Power, Prentice-Hall, Inc., New York, 1946, pp. 115–176.
[20] Chemical Engineering, Atomic Energy—Its Future in Power Production: Vol. 53, No. 10, October 1946, pp. 125–134.
[21] Wagner, C. F., and Hutcheson, J. A., Will an Atomic Power Plant Pay?: Power Plant Eng., vol. 50, No. 10, October 1946, pp. 118, 120, 122, 124.

Costs and income of nuclear power stations (estimated) compared with coal-fueled power stations, in thousands of dollars [1]

[Northern California Association of Scientists]

Item	500,000-kw. primary pile	100,000-kw. plant		20,000-kw. plant	
		Plutonium	Coal	Plutonium	Coal
CAPITAL COSTS					
Land and improvements	$2,000	$100	$600	$60	$60
Buildings (except piles)	8,500	2,000	3,000	700	1,000
Pile units and accessories	24,000	2,000		1,100	
Fuel handling and storage	200	100	2,000		
Boiler plant	7,500	1,000	1,500	600	1,000
Other equipment	26,500	5,900	6,100	1,220	1,220
Total capital costs	68,700	11,100	13,200	3,680	3,280
OPERATING COSTS (ANNUAL)					
Fuel	$100	$1,000	$1,000	$270	$360
Wages and salaries (at $4,000)	800	160	240	80	100
Maintenance and supplies	1,000	150	120	40	30
Fixed charges (15 percent)	10,300	1,660	1,980	570	490
Total operating costs	12,200	2,970	3,340	960	980
INCOME (ANNUAL)					
Sale of power [2]	$8,800	$3,290	$3,290	$965	$965
Sale of plutonium (250 kg.)	5,000				
Sale of tracers (at $500 per gm.)		250		50	
Total income	13,800	3,540	3,290	1,015	965
Income above costs (annual)	$1,600	$570	(3)	$55	(3)

[1] Assumptions: Plant factor of 50 (4,380 kw.-hr. per year per kilowatt installed capacity). Utilization factor of 90 (peak load is 90 percent of rated capacity). Costs for coal plants representative of plants in 1946 designed in the United States. Data for atomic pile units are preliminary estimates. Fuel prices based on coal at $6 per short ton, uranium at $10 per pound, and plutonium at $20 per gram.

[2] Power at 500,000-kw., 100,000-kw., and 20,000-kw. plants valued at 4, 7½, and 11 mills, respectively.

[3] Apparent deficit probably a result of using conservative figure for sale of power.

Competitive costs of plutonium and coal

[Northern California Association of Scientists]

Assumed cost of coal (per short ton) in stations of—		Permissible competitive [1] cost of plutonium (per gram)	Assumed cost of nuclear power station		Permissible competitive [2] cost of plutonium (per gram)
100,000 kw.	20,000 kw.		100,000 kw.	20,000 kw.	
--------	$3	$11	$9,000,000	$2,500,000	$8
--------	4	15	--------	2,000,000	14
--------	5	20	6,000,000	--------	19
$3	--------	21	--------	1,500,000	20
--------	6	24	--------	1,100,000	24
4	--------	25	4,000,000	--------	25
5	--------	28	--------	800,000	27
6	--------	31	2,000,000	--------	31
--------	10	42	1,000,000	--------	34
10	--------	44			
12	12	51			

[1] Assumption: Nuclear power stations of 100,000 kw. and 20,000 kw., costing $2,000,000 and $1,100,000 respectively.

[2] Assumption: Coal costing $5 per short ton.

factor of 50 percent, at 4.4 to 6.4 mills per kilowatt-hour if uranium metal cost $5 a pound (equivalent to coal at $2 to $6 per short ton), or at 5.1 to 7.1 mills if uranium cost $20 a pound (equivalent to coal at $4 to $7 a ton).

Manhattan District Release.—Prime contracts for the development of industrial atomic power have been awarded by the Manhattan District to Monsanto Chemical Co., St. Louis, Mo., and to General Electric Co., Schenectady, N. Y., according to a War Department release of November 22, 1946. The Monsanto firm was working on a power pile based on designs by Farrington Daniels, professor of chemistry at the University of Wisconsin and chairman of the board of trustees of the Argonne National Laboratory, Chicago. A pilot plant will be built at Oak Ridge, Tenn., but difficulties of procurement of equipment may delay completion until 1948.

RADIOISOTOPES

Isotopes, as previously pointed out, are varieties of the same element that differ slightly in weight but have identical chemical properties. Many are radioactive and are thus called radioisotopes. Certain of these offer promise in the treatment of cancer and other diseases and in the promotion of special chemical reactions. The greatest demand quantitatively for radioisotopes is as "tracers"; materials in the bodies of animals and plants or in industrial batches can be "tagged" with small quantities of an isotope, the radioactivity of which makes possible accurate measurement of circulation and of distribution of components in biological processes and chemical reactions. Radioisotopes may be derived (1) by irradiation of elements or compounds placed in a chain-reacting pile or in a cyclotron, (2) by fission of uranium-235 in a pile, and (3) by physical separation from the commoner substance in which they are dispersed.

The availability of radioisotopes in mid-1946 was described by the Manhattan District,[22] which stated that most of the radioisotopes in greatest demand must be produced by irradiation of materials foreign to the pile. Existing pile facilities do not permit production of a sufficient quantity and quality of many radioisotopes to meet anticipated national demands. To accomplish this, it would very likely be necessary to build piles especially designed for the purpose. The cyclotron yields a greater variety of isotopes than does a pile but is extremely limited as regards quantity of output.

Although large numbers of radioisotopes are formed in abundance by the fission of uranium in piles, their availability is restricted by difficulties encountered in isolating them. It has not yet been found possible to remove individual fission products from waste solutions of the plutonium extraction process. Most of the few fission products being made available are not salvaged byproducts of the plutonium process but are items requiring special production from unprocessed irradiated uranium.

[22] Manhattan Project Headquarters, Availability of Radioactive Isotopes: Science, vol. 103, No. 2685 June 14, 1946, pp. 697–705.

Radiocarbon.—Irradiation of calcium nitrate in a uranium pile produces by transmutation carbon–14, a radioisotope with a half-life[23] of about 5,100 years and priced by the Manhattan District at $367 a millicurie[24] in the latter part of 1946 and $50 a millicurie after February 1947. As carbon is the fundamental "building block" of living animal and plant matter and of industrial organic materials such as petroleum products, coal chemicals, and plastics, the importance of a radioactive carbon tracer is evident. The first radioactive material made available by the Manhattan District for civilian research was carbon–14. At a ceremony at Oak Ridge, Tenn., August 2, 1946, about 1 milligram of the precious isotope was delivered by E. P. Wigner, research director of the Clinton Laboratories, to E. V. Cowdry of Barnard Free Skin and Cancer Hospital, St. Louis, Mo. It was in the form of barium carbonate and was subsequently built into a cancer-producing agent (20–methylcholanthrene) by the Kettering Foundation for the Study of Chlorophyll and Photosynthesis, Antioch College, Yellow Springs, Ohio. There is a potential demand in the United States for several thousand grams of carbon–14 annually if the price is low, according to the Northern California scientists study,[25] which estimated that a 100,000-kilowatt nuclear power station could produce 100 to 1,000 grams of the isotope annually and sell it profitably at a price of 50 cents a milligram.

Radioiodine and Radiophosphorus.—Only two artificially radioactive elements—iodine and phosphorus—have proved conclusively to have therapeutic value.[26] Iodine–131, a fission product of uranium, is a cure of hyperthyroidism (overactivity of the thyroid gland). It has a half-life of 8 days and was priced at $1.69 a millicurie by the Manhattan District. Estimated annual requirements in the United States are 337 curies for hyperthyroidism and 40 curies for attempts at controlling thyroid cancer. Phosphorus–32, produced by pile irradiation of sulfur, is the best of known therapeutic agents for polycythemia (overactive formation of red blood corpuscles). It has a half-life of 14 days and was priced by the Manhattan District at $1.09 a millicurie in the form of pure dibasic sodium phosphate and 5 cents a millicurie unseparated from its sulfur carrier. Estimated annual requirements are 151 curies for polycythemia and 180 curies for attempts at remitting luekemia (malignant overactive formation of white blood corpuscles). An advantage of radiophosphorus over X-rays is freedom from radiation sickness.

Other Radioisotopes.—About 80 other radioisotopes were announced as available from the Manhattan District, Oak Ridge, Tenn.; they were priced in a list dated June 28, 1946.

NONENERGY USES

Uranium.—Consumption of uranium in nonenergy applications was further restricted and in 1946 totaled only 2 tons. The largest consumer in this class was the chemical industry, which utilizes uranium

[23] Time required to decay to one-half its former size and radioactive intensity. Decay proceeds at an inverse geometric rate; that is, at the end of the first decay period one-half of the original quantity remains, at the end of the second period one-fourth, at the end of the third period one-eighth, etc.

[24] A millicurie is the intensity of radioactivity equivalent to that possessed by 1 milligram of radium, that is, 3.7×10^7 disintegrations per second.

[25] Work cited in footnote 20, p. 131.

[26] Rhoads, C. P., and Solomon, A. K., Therapeutic Uses of Artificial Radioactivity. Work cited in footnote 17, pp. 53–61.

acetate and nitrate as analytical reagents in the determination of sodium and zinc. All the uranium allocated to the ceramic industry in 1946 went into glass of specific coefficients of expansion for glass-to-metal contacts in vacuum tubes and into amber-colored glass for signal lights and lenses. Small quantities of uranium were used to tone motion-picture film and to make negative-temperature-coefficient resistors, according to the Atomic Energy Commission.

Consumption of uranium compounds for nonenergy purposes in the United States, 1943–46, in pounds of contained U_3O_8

[Atomic Energy Commission]

Industry	1943	1944	1945	1946
Chemical	4,000	6,700	3,800	2,500
Photographic				360
Electrical	250	800	1,000	300
Ceramic (including glass)	7,500	100	150	1,000
Total	11,750	7,600	4,950	4,160

Thorium.—Gas mantles are treated with thorium nitrate, and some special refractory crucibles are made of thorium oxide. Certain optical glass batches have included thorium.

STOCKS

Industry stocks of monazite exceeded 4,000 short tons at the end of 1944 but were greatly reduced in 1945–46 as a result of meager imports. The Government completed a war-inspired stock pile of 3,262 short tons of monazite by May 1944. No data on stocks of uranium are available for publication.

PRICES

Uranium.—Carnotite ore and concentrates containing 1.06 percent U, 3.23 percent V, and 3.2 milligrams Ra per ton shipped from domestic mines in 1940 had an average value of $78 a short ton; corresponding data for recent years are not available. The first postwar prices on uranium in ore—quoted in May 1947 by the Vanadium Corp. of America—are shown in the accompanying table. The corporation stated at the time that ore containing over 6 percent $CaCO_3$ may be rejected. Pure uranium metal cost $22 a pound in 1942, according to the Smyth report. The Northern California scientists valued refined uranium at $10 a pound and plutonium at $20 a gram in their recent cost study.[27] Oil, Paint and Drug Reporter quoted black uranium oxide unchanged at $2.55 a pound and uranium yellow (sodium uranate) at $1.65 a pound throughout 1946. Canadian Chemistry and Process Industries during the same period listed black uranium oxide at $3.35 a pound, uranium nitrate at $2.85 a pound, and yellow or orange sodium uranate at $2.20 a pound.

[27] Work cited in footnote 20, p. 132.

Prices offered for uranium oxide contained in ores and concentrates, delivered to Naturita, Colo., May 1947

U_3O_8 contained (percent)	Value	U_3O_8 contained (percent)	Value
	Per pound		*Per pound*
0.20–0.30	$0.35	1.26–1.50	$0.80
0.31–0.40	.40	1.51–1.75	.90
0.41–0.50	.50	1.76–2.00	1.00
0.51–1.00	.60	2.01 and over	1.10
1.01–1.25	.70		

Thorium.—Monazite concentrates, minimum 8 percent ThO_2, were quoted nominally at $60 a short ton by E&MJ Metal and Mineral Markets during the first 5 months of 1946. The quotation, specifying 70 percent rare-earth oxides, f. o. b. Atlantic ports, was $70 a ton from June to November and lowered to $65 a ton in December 1946. Thorium metal, 98–99 percent, pound lots, was quoted at 3½ d. a gram by the Metal Bulletin (London) and thorium nitrate at $2 a pound by Oil, Paint and Drug Reporter during 1946.

FOREIGN TRADE [28]

Imports.—Belgian Congo and Canada have been the principal sources of imported uranium, and Brazil and India have supplied most of the imported thorium, according to such figures for recent years as are available and are published in the accompanying tables. The uranium compounds from Belgium are believed to have been manufactured entirely from Congo concentrates.

Uranium ore, concentrates, and compounds imported for consumption in the United States, 1937–46

Year	Uranium ore and concentrates				Uranium oxide and salts				
	Pounds from—			Value	Pounds from—				Value
	Belgian Congo	Canada	Total		Belgium	Canada	Other countries [1]	Total	
1937	(2)	(2)	(2)	(2)	160,072	37,846	5,555	203,473	$258,417
1938	(2)	(2)	(2)	(2)	287,752	88,954	2	376,708	520,540
1939		5	5	$10	1,333,053	106,271		1,439,324	1,197,786
1940	2,400,198		2,400,198	2,110,927	169,388	70,811		240,199	388,355
1941					[3] 53,090	334,415		387,505	501,370
1942	525,559	15,748	541,307	806,919		377,398		377,398	851,098
1943	(4)	(4)	(4)	(4)		211,348		211,348	413,410
1944	(4)	(4)	(4)	(4)		4,675	5,750	10,425	11,074
1945	(4)	(4)	(4)	(4)		1,080		1,080	2,244
1946	(4)	(4)	(4)	(4)		25		25	41

[1] 1937–38: Germany; 1944: United Kingdom.
[2] Data not separately recorded.
[3] Reported by U. S. Department of Commerce from Belgian Congo, but presumably originated in Belgium if actually a finished compound rather than a concentrate.
[4] Data not available for publication.

[28] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Thorium ore, concentrates, and compounds imported for consumption in the United States, 1936–45 [1]

Year	Monazite sand and other thorium ore and concentrates					Thorium compounds	
	Short tons from—				Value		
	Brazil	India [2]	Other countries [3]	Total		Pounds [4]	Value
1936		119	488	607	$25,324	4,411	$5,578
1937		336		336	13,579		
1938	110	346		456	18,210		
1939	54	1,336	170	1,560	52,016		
1940	201	2,766		2,967	99,827		
1941	747	2,763		3,510	107,306		
1942	1,346	3,052		4,398	175,483		
1943	1,911	3,069		4,980	220,480		
1944		384		384	13,782		
1945	437	112		549	19,581	25	5

[1] Data for 1946 not available for publication.
[2] Includes following quantities originating in India but reported by U. S. Department of Commerce from United Kingdom: 1936, 29 tons; 1938, 7 tons; 1943, 36 tons.
[3] 1936: Ceylon; 1939: Netherlands East Indies.
[4] 1936: France (4,410) and Germany (1); 1945: Canada.

Exports.—Canada was the destination of the exported uranium and thorium ores and concentrates shown in the accompanying table. Of the uranium oxide and salts exported between mid-1941 and the end of 1945, 55 percent went to Latin America, 24 percent to Canada, 16 percent to Sweden, and 5 percent to other countries. Of the thorium compounds exported in the same period, 31 percent went to Canada, 28 percent to Russia, 21 percent to Egypt, 10 percent to India, 6 percent to China, almost 3 percent to France, 1 percent to Argentina, and much less than 1 percent to several other countries.

The Office of International Trade in September 1946 tightened export controls covering shipments moving under general in-transit licenses to prevent exportation of ores, concentrates, and compounds of uranium; metal, alloys, and compounds of thorium; metal and compounds of polonium; and compounds of actinium.

Uranium and thorium ores, concentrates, and compounds exported from the United States, 1941–45 [1]

Year	Uranium				Thorium			
	Ore and concentrates		Oxide and salts		Ore and concentrates		Compounds	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1941 [2]			604	$2,256			36,875	$50,700
1942	1	$1,076	426	1,827			30,872	51,056
1943			321	1,972			33,191	45,703
1944			221	1,064	5	$325	13,560	25,348
1945	(1)	(1)	150	993	(1)	(1)	10,790	41,122

[1] Data for 1945 (except compounds) and for 1946 not available for publication.
[2] July to December, inclusive; earlier data not separately recorded.

TECHNOLOGY

Methods of exploring for radioactive ores,[29] analyzing uranium materials,[30] and measuring radiation [31] were described in 1946. Some of the metallurgical problems involved in the production of fissionable metals were discussed.[32]

The hazard of a new, highly efficient process being discovered which would render obsolete all existing nuclear plants is a very real one as long as no general theory for the behavior of atomic nuclei exists; once the theory has been developed and worked for some years the chance of a complete revolution decreases substantially.[33] One example of the effect of technologic advancement was noted in December 1946, when the Atomic Energy Commission was informed that improvement in the isotope-separation processes at Oak Ridge would permit considerable savings in operating costs and substantial reduction in the number of employees required at one plant.

WORLD REVIEW

Uranium-radium ore production at the onset of World War II centered in the Belgian Congo and Canada, but there was some output also in the United States, Czechoslovakia, and Portugal.

World production of monazite in 1893–1938 totaled 107,347 metric tons—61 percent in Brazil, 32 percent in India, 5 percent in the United States, and 1 percent each in the Netherlands East Indies and Ceylon.[34]

AMERICA

Brazil.—Production of monazite in Brazil in 1895–1938 totaled 65,612 metric tons. The bulk of the output was from coastal sands in the States of Bahia and Espirito Santo. Uranium minerals such as samarskite, euxenite, and polycrasite occur in some of the beryl-tantalite pegmatites of Minas Gerais and Paraiba, and the Brazilian Academy of Sciences has urged the Brazilian Government to allocate funds for intensified research to determine in what quantities uranium is present.

Canada.—One of the world's principal uranium mines is at La Bine Point, on the east shore of Great Bear Lake, Northwest Territories. It is operated by Eldorado Mining & Refining Co., a Crown company that took over the property from Eldorado Gold Mining Co. January 28, 1944. Geology, development, and milling at the Eldorado mine were described.[35] Field parties, continuing work done in previous years, were active in the summer of 1946 exploring Northwest Terri-

[29] Rose, R. Burton, Radioactive Exploration: Min. World, vol. 8, No. 9, August 1946, pp. 46–48.
Senftle, Frank E., Relation of Conductivity and Total Solid Content of Lake Water to Its Radium Content, Great Bear Lake Region: Trans. Canadian Inst. Min. and Met., vol. 49, 1946, pp. 439–446.
[30] Scribner, Bourdon R., and Mullin, Harold R., Carrier-Distillation Method for Spectographic Analysis and Its Application to the Analysis of Uranium-Base Materials: Jour. Research Nat. Bur. Standards, vol. 37, No. 6, December 1946, pp. 379–389.
[31] Korff, Serge A., Electron and Nuclear Counters: D. Van Nostrand Co., New York, 1946, 212 pp.
[32] Smith, Cyril Stanley, Allison, S. K., Jeffries, Zay, Kinzel, A. B., and Chipman, John, Atomic Energy and Its Implications: Metal Prog., vol. 49, No. 4, April 1946, pp. 761–782.
Keith, P. C., The Role of the Process Engineer in the Atomic Bomb Project: Chem. & Met. Eng., vol. 53, No. 2, February 1946, pp. 112–122.
[33] Chemical Engineering, work cited in footnote 20, p. 127.
[34] Houk, Lawrence G., work cited in footnote 6, pp. 11–12.
[35] Murphy, Richard, Howard, Henry, and other staff members, The Eldorado Enterprise: Trans-Canadian Inst. Min. and Met., vol. 49, 1946, pp. 423–438.

tories for other uranium deposits. The International Uranium Mining Co., Ltd., continued development of its silver-uranium property (purchased in 1944 from Bear Exploration & Radium, Ltd.) at Contact Lake, southwest of the Eldorado mine; the power plant and some other buildings were damaged in a fire November 1946, but plans to reopen the property remained active.

Pitchblende concentrates from the Eldorado mine are shipped to the Government refinery at Port Hope, Ontario. During World War II the refinery was modernized from batch operation to continuous circuit. In recent years Canada exported a substantial supply of uranium to the United States under contract and a small quantity to the United Kingdom, it was officially stated by C. D. Howe, Minister of Reconstruction.[36]

The National Research Council is to operate a uranium-heavy-water chain-reacting pile and other equipment under construction during 1945 and 1946 at the National Institute for Nuclear Research, Chalk River, Ontario. The Institute—as well as the Eldorado mine, Port Hope refinery, and a plutonium-heavy-water unit in western Canada—will be operated in accordance with the policy of the Atomic Energy Control Board, established by the provisions of the Atomic Energy Control Act passed by the Dominion Parliament in June 1946. C. D. Howe, as chairman of the Committee of the Privy Council on Scientific and Industrial Research, was appointed director of the five-man control board. Canada's investment in atomic energy research and development reached $27,000,000 by early 1946.

Mexico.—All deposits of uranium, thorium, actinium, and other radioactive elements discovered in future in Mexico were withdrawn from private exploitation and placed in the National Mineral Reserve, according to a decree effective September 17, 1945, and amended October 17, 1946.

AFRICA

Belgian Congo.—The Chinkolobwe mine of the Union Minière du Haut Katanga exploits one of the largest known deposits of uranium in the world. Before World War II it shipped enough concentrates to Belgium to sustain an output of as much as 60 grams of radium annually. Shipments of 1,089 metric tons of uranium concentrates to the United States in 1940 and 238 tons in 1942 were recorded by the United States Department of Commerce before censorship was imposed.

Madagascar.—A few hundred tons of uranium concentrates have been produced in Madagascar and exported to France. Betafite was mined at Ambatofotsy and Amparitena, euxenite in the vicinity of Ankazove, and autunite in alluvium of the Fitamalama River, 16 miles south-southeast of Antsirabe. Exports of uranium minerals were 49 kilograms in the first quarter 1946 and none in the second and third quarters. The Paris decree of April 5 was promulgated in Madagascar by the Governor General's order of July 3, 1946, reserving to the State all new rights for research and exploitation of uranium, thorium, and beryllium ores.

[36] Northern Miner, Radioactive Ore Control Looms: Vol. 32, No. 11, June 6, 1946, p. 4.

EUROPE

Austria.—The principal refiner of uranium-radium ores in German-occupied Europe during World War II was Treibacher Chemische Werke, A. G., at Treibach, 18 miles north of Klagenfurt, Carinthia, south-central Austria. The plant, undamaged by hostilities, treated about two-thirds of the pitchblende mined in Czechoslovakia during the war; it produced uranium compounds in 1940–44 containing 28,964 kilograms of U_3O_8—all shipped to Germany. Stocks at Treibach in June 1945 included 4,500 kilograms of U_3O_8 in ammonium uranate and sodium uranate and 4,500 kilograms of pitchblende.[37]

Belgium.—The Société Générale Métallurgique de Hoboken, subsidiary of Union Minière du Haut Katanga, operates a refinery at Oolen, near Antwerp, for treating Congo ore. Exports of uranium oxide were officially reported at 150 metric tons in 1936, 82 in 1937, 130 in 1938, and 88 in 1939. However, the United States reported receipts from Belgium of 605 metric tons of oxide in 1939 and 77 tons in 1940.

Bulgaria.—A deposit at Goten, 13 miles northeast of Sofia, is said to contain 25,000 tons of ore averaging 2 percent U.[38]

Czechoslovakia.—Mines at Jachymov (Joachimsthal), Bohemia, were worked for silver in the 16th century, for uranium as a glass colorant since about 1830, and for radium since 1898, when the Curies discovered the then new element in the ore. Ore produced in the late 1920's and early 1930's yielded about 13 metric tons of uranium compounds and 2 or 3 grams of radium annually. Production at Jachymov (including some 10 percent at nearby Schmiedeberg) in 1939–44, during German occupation, totaled about 110 metric tons of pitchblende concentrates containing some 40 percent recoverable U_3O_8 and about 175 milligrams of recoverable Ra per ton, according to Singer.[39] Two-thirds of that output was refined at Treibach, Austria, and one-third in Brunswick, Germany. In 1946 the Czechoslovak Government announced [40] its establishment of full control over the Jachymov mine and resumed operations.

France.—Uranium minerals have been known for many years to occur near Autun, Saône-et-Loire; Beauregard, Nièvre; and elsewhere in France. Particular interest was aroused in 1946 in uranium deposits in the vicinity of Limoges, Haute-Vienne.[41] Control of atomic energy in France was implemented by the establishment of a Commissariat of Atomic Energy October 18, 1945, and the enactment of a decree April 5, 1946, reserving to the Government rights for research on and exploitation of uranium, thorium, and beryllium ores in all French colonies (except the Antilles and Réunion). Plans are being formulated [42] to construct a huge experimental laboratory for atomic energy on the Saclay Plateau, near Orsay, west of Paris.

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[37] Singer, R., and others, The Cerium Industry in German Territory, Including Reports on Radium and Mesothorium: British Intelligence Objectives Subcommittee Report 400, September 1945, 104 pp. Abs. in Bureau of Mines, Mineral Trade Notes, vol. 24, No. 1, January 1947, pp. 32–35.

[38] Kostov, Ivan, Metallization of the Balkan Peninsula: Mining Mag. (London), vol. 68, No. 5, May 1943, pp. 261–274.

[39] Singer, R., and others, work cited in footnote 37.

[40] Chemical Age (London), vol. 54, No. 1393, Mar. 9, 1946, p. 269.

[41] Cass, W. G., Rich Uranium Deposits in France: Chem. and Eng. News, vol. 24, No. 23, Dec. 10, 1946, p. 3240.

[42] Joliot-Curie, Frederic, Atomic Power—The Perfect Slave: United Nations World, vol. 1, No. 2, March 1947, pp. 19–23, 78.

Germany.—In 1939–43 Germany produced from 49,017 metric tons of ore 1,699 tons of uranium-bismuth-cobalt-nickel concentrates containing 35 tons of U_3O_8;[43] the source, although not specified, was probably Schneeberg, Saxony. The ultimate progress of German research toward development of uranium bombs has not been publicly revealed, but the following comments [44] are suggestive:

> Allied investigators found in Germany nuclear research reports data on almost all of the basic concepts used by Allied atomic workers. The ideas in both cases were fundamentally similar or even identical, but the emphasis was different—enough different, as it turned out, to put the Nazis on the wrong track. The Germans, for example, never once came to understand how much of the job of making atomic bombs was purely an industrial and engineering undertaking * * * Nazi Germany's inefficient scientific mobilization had something to do with it.

Norway.—Government geologists mapped uranium deposits in 1946, and a small mine was opened.[45] All such deposits are subject to government control in accordance with a Royal Resolution of December 7, 1945. Norsk Hydro-Elektrisk Kvaelstofaktieselskab has a unit at Rjukan for producing heavy water, a moderator for atomic reactions; the plant was effectively damaged by a Norwegian-British land party during the German occupation, but production is said to have been resumed after the liberation.

Portugal.—Production was 330 metric tons of autunite ore (1–1.8 percent U_3O_8) in 1941, but data for 1942–45 are not available. In the first quarter of 1946 there was no output of uranium ore, according to a minerals attaché report from the American Embassy at Lisbon.

Spain.—There has been no reported production of uranium in Spain, but the Director General of Mines and Fuels published October 4, 1945, a provisional order reserving to the State uranium deposits in 14 Provinces. Some Spanish occurrences were described.[46]

Sweden.—The $25,000,000 shale-oil plant at Kvarntorp, Province of Narke, treats shale averaging about 0.02 percent U_3O_8. Sweden's shale-oil deposits contain 225,000 metric tons of uranium oxide, Gustav Egloff, director of research of Universal Oil Products Co., estimates.[47]

United Kingdom.—Pitchblende has been produced in Cornwall, notably some years ago at the South Terras mine, Grampound Road, and at the Trenwith mine, St. Ives. Geologists are reportedly making a new survey of the deposits.[48] A chemical defense plant at Salwick, near Preston, is to be converted to a uranium refinery, where pitchblende concentrates will be reduced to metal and the metal machined into uranium rods.[49] The Atomic Research Station, including two chain-reacting piles and a heavy-water-production unit, was under construction at Harwell, near Didcot, during 1946; the smaller pile, according to J. D. Cockcroft, director of atomic research, was expected to operate a few months after the end of the year.[50] The Government purchased the radiochemical business and plant at Amersham, Bucks,

[43] Bureau of Mines, Mineral Trade Notes: Vol. 21, No. 2, Aug. 1945, p. 12.
[44] Goudsmit, S. A., The Nazis Came Close—But: Chem. and Eng. News, vol. 24, No. 16, Aug. 25, 1946, pp. 2176, 2263.
[45] Metal Industry (London), vol. 70, No. 2, Jan. 10, 1947, p. 37.
[46] Gastón, Miguel Moya, (Deposits of Uranium): Inst. Civil Eng. Conference, Madrid, 1946, pp. 19–30.
[47] Chemical and Engineering News, Swedes Recover Oil from Shale: Vol. 25, No. 7, Feb. 17, 1947, p. 430.
[48] Mining World and Engineering Record (London), vol. 150, No. 3911, Mar. 16, 1946, p. 303.
[49] Chemistry and Industry (London), No. 15, Apr. 12, 1947, p. 200.
[50] Abrahamson, G., Atomic Research Station to Operate First Pile: Chem. and Eng. News, vol. 25, No 5, Feb. 3, 1947, p. 330.

of Thorium, Ltd., which as agent of the Ministry of Supply will operate a national center for processing and distributing thorium, radium, and artificial radioactive substances. The Atomic Energy bill passed by the House of Commons in October 1946 envisaged an expenditure of £30,000,000 on the project.[51] About £2,800,000 of this was spent in the fiscal year beginning April 1, 1946, according to press reports. Ores and concentrates of uranium and thorium were placed under export control after the middle of 1946.

ASIA

Ceylon.—Large deposits of monazite and meager occurrences of thorianite and zirkellite have been known in Ceylon for some years. Production of monazite was 773 metric tons in 1918–29 and none in 1930–38. During the first half of 1946 the Government Mineralogist's Department was conducting further investigations of the deposits, and legislation regulating production of radioactive minerals was being drafted.[52]

India.—An important source of monazite is the marine and fluvial beach sand of Travancore. Production of monazite totaled 34,593 metric tons in 1911–38.

Netherlands East Indies.—The Netherlands Indies produced 1,431 metric tons of monazite in 1936–38. The principal source was the tin-mining island of Billiton in the Java Sea.

U. S. S. R.—Stalactitic varieties of tuyamunite, volborthite and turanite have been mined intermittently at Tuya-Muyun (40°21′22″ N., 72°35′01″ E.), Ferghana, Turkestan. The crude ore averaged 1.1–1.4 percent U_3O_8 and also contained radium, vanadium, and copper.

AUSTRALIA AND NEW ZEALAND

Australia.—The autunite-torbernite deposits in the Mount Painter area, South Australia, some 400 miles north of Adelaide, have yielded to date about 138 metric tons of selected uranium-radium ore valued at £10,000, chiefly the value of the radium. Readily available reserves in the area are estimated at 500 tons of ore averaging 0.33 percent UO_3. Detailed exploration was conducted for the British Government at Mount Painter between June 1944 and February 1945, but the only output during the period was a small quantity of ore for ore-dressing studies. The Control of Materials Act of 1946 reserved all deposits of uranium and thorium ores to the Crown.[53] The South Australian budget for 1947 provides £10,000 (probably to be increased) for development of the Mount Painter deposits.[54]

New Zealand.—The Department of Scientific and Industrial Research is investigating the occurrence of radioactive minerals throughout the Dominion. No deposits believed to be of economic

[51] Mining Journal (London), vol. 227, No. 5800, Oct. 19, 1946, p. 826.
[52] Mining Journal (London), vol. 226, No. 5784, June 29, 1946, p. 509.
[53] Chemical Engineering and Mining Review (Melbourne), South Australian Uranium Deposits: Vol. 38, Sept. 10, 1946, p. 454.
[54] Industrial Australian and Mining Standard (Melbourne), Uranium Ore Development in S. A.: Vol. 102, No. 2595, Feb. 1, 1947, pp. 987–988.

importance at present have been found, but certain mineral by-products of gold dredging on the west coast of South Island may represent a potential source. For instance, 3 percent of the concentrate from one dredge was uranothorite with 12 percent UO_2 and nearly 70 percent ThO_2; 8 percent of the concentrate from another dredge was monazite containing 2 percent UO_2 and 4 percent ThO_2.[55] Research on methods of concentration has been initiated. In accordance with the New Zealand Atomic Energy Act, effective December 7, 1945, the Government controls the mining and processing of uranium and other source materials.

[55] Chemical Engineering and Mining Review (Melbourne), Search for Radio-Active Minerals in New Zealand: Vol. 38, No. 450, Mar. 11, 1946, p. 194.

Vanadium

By EDWIN K. JENCKES

GENERAL SUMMARY

THE decrease in production and consumption of vanadium ores that occurred in 1945 continued in 1946, marking it as the third successive year of decline from the all-time high established in 1943. Production in 1946 was 1,272,148 pounds (of contained vanadium), a drop of 1,691,765 pounds from that in the previous year; and consumption of domestic ores was 1,495,839 pounds, a decrease of 2,325,580 pounds.

For the third successive year consumption of domestic ores exceeded production, with a corresponding decrease in inventories of mined-ore stocks. Visible stocks of vanadium oxide declined, while inventories of ferrovanadium increased moderately.

Imports and exports of vanadium ore and concentrates (791,057 pounds and 6,051 pounds, respectively) showed marked declines from those in 1945.

Salient statistics of the vanadium industry in the United States, 1942–46, in pounds of vanadium contained

	Pounds of vanadium contained				
	1942	1943	1944	1945	1946
Mine shipments of ores and concentrates [1]	4,439,130	5,586,492	3,527,054	2,963,913	1,272,148
Imports:					
Ore or concentrates	2,422,376	2,052,620	1,284,603	1,552,307	791,057
Vanadium-bearing flue dust	154,028	64,393	40,171	26,293	20,931
Exports of ore, concentrates, and vanadium oxide	22,140	38,180	6,254	113,927	6,051
Consumption (domestic ores only)	3,914,673	5,179,290	4,113,309	3,821,419	1,495,839

[1] Measured by receipts at mills and Government purchasing depots.

GOVERNMENT REGULATIONS

Department of Justice.—In October the defendants in the antitrust suit instituted by the Attorney General in 1945 filed a motion seeking dismissal of the suit and a bill of particulars.[1] The motion was argued and denied, and the case is now awaiting the setting of a trial date.

Atomic Energy Commission.—The actions taken by the Atomic Energy Commission and their implications with respect to the mining of carnotite ores are discussed in the section of this chapter on domestic production. Further details are contained in the Uranium and Thorium chapter of this volume.

[1] Mining Record, Vanadium Trust Asks Dismissal of Case in U. S. Court: Vol. 57, No. 49, Dec. 5, 1946, p. 3.

DOMESTIC PRODUCTION

The production of domestic vanadium ores in the past 10 years is given in the accompanying table.

Vanadium in ores and concentrates produced in the United States, 1937–46 [1]

Year	Pounds of vanadium	Year	Pounds of vanadium
1937	1,086,125	1942	4,439,130
1938	1,613,155	1943	5,586,492
1939	1,984,068	1944	3,527,054
1940	2,162,916	1945	2,963,913
1941	2,513,051	1946	1,272,148

[1] Data for 1940–46 are receipts at mills and Government purchasing depots.

United States production for the period 1910–46, inclusive, totaled 44,415,000 pounds of contained vanadium; 1910 records the first commercial production of vanadium ores in the United States.

The sandstones of Colorado, Utah, and Arizona furnished the largest source of domestic vanadium in 1946; New Mexico, an important producer during the war, had no output in 1946. The important minerals in the sandstone ores are carnotite and the group of minerals locally called roscoelites. The supply from these ores is augmented by byproduct recovery of vanadium from phosphate rock mined in Idaho. Potential sources not currently productive are the shales of the Phosphoria formation of Utah, Idaho, and Wyoming, and vanadium-bearing titaniferous magnetites, particularly those adjacent to Sanford Lake, N. Y. Lead vanadates have been mined in Nevada and Arizona, but no commercial recovery of vanadium from this source has been reported to the Bureau of Mines.

Prior to the development of atomic fission two factors operated to prevent utilization of carnotite ores as ordinarily found as sources of uranium compounds, namely the generally low content of U_3O_8 in the ore and the limited market for uranium. Before World War II the demand for uranium was so small that it could be supplied easily by the rarely found carnotites of high U_3O_8 content; and it is understood that, in the case of these ores, the U_3O_8 only was paid for. In the ordinary vanadium-refining process in use before the war (salt roast), the uranium remained in the sands from which the vanadium had been extracted and found its way to the tailings pile. Under these conditions the U_3O_8 content had no commercial value and was not paid for.

There has been a strong and growing demand from vanadium miners that the uranium in ores be paid for. The miners claim that the mining of carnotite has been restricted by several factors including: (1) The little-publicized provisions of War Production Board Order M–285; (2) the imperfectly understood provisions of the Atomic Energy Act, which were misinterpreted as restricting discussions of and transactions in uranium ore; and (3) the inability of the Atomic Energy Commission to function pending confirmation of its members by the Senate.

Following confirmation of the Commission's membership steps have been taken to receive and examine applications for licenses for the disposal of uranium-bearing ores and materials, and with this end in view a visit has been made to the carnotite-producing region by L. C. Burman, chief of the Licensing Branch of the Commission.[2]

The Vanadium Corporation of America has offered to purchase carnotite ores on the basis of the combined oxides of uranium and vanadium.[3]

The unprecedented increase in alloy-steel production during the war years required a corresponding increase in the output of vanadium and resulted in shortages in 1941–42. By the fall of 1943, however, the supply of vanadium had overtaken the demand; hence, allocation controls under WPB Order M–23 were terminated.

During the 7-year period 1940–46, 22½ million pounds (contained vanadium) were produced in the United States. This represents over half of the vanadium that has been mined domestically since production was first recorded in 1910. Wartime requirements and postwar needs sustained this enormously expanded output, and domestic resources proved responsive to the sudden demand. Inasmuch as large quantities of the sandstone ores have been mined in meeting the emergency, the desirability of developing other known but latent sources of vanadium can well be appreciated.

REVIEW BY STATES

The accompanying table shows production of vanadium ores by all producers, by States, measured in terms of receipts at mills.

Vanadium in ores and concentrates produced in the United States, 1942–46, by States, in pounds

State	Pounds of vanadium contained				
	1942	1943	1944	1945	1946
Colorado	3,071,330	4,159,830	3,058,727	2,701,103	1,036,050
Utah	1,075,596	833,680	287,045	97,572	63,188
Other [1]	292,204	592,982	181,282	165,238	172,910
	4,439,130	5,586,492	3,527,054	2,963,913	1,272,148

[1] Includes Arizona and Idaho, 1942–46; Nevada, 1942–43; and New Mexico, 1943–44.

Arizona.—Two producers made small deliveries of ore in 1946. Mammoth-St. Anthony Ltd. (Tiger, Ariz.), Arizona's oldest vanadium producer, did not recover any vanadium from its complex ores in 1945 or 1946.

Colorado.—Only one refining plant, that of the United States Vanadium Corp. at Rifle, was in operation in 1946. The Bureau has received reports of deliveries varying in quantity up to 20,000 pounds of contained V_2O_5 from 19 independent mine operators.

Idaho, Montana, and Wyoming.—The byproduct recovery of vanadium by the Anaconda Copper Mining Co. from phosphate rock

[2] Mining Record, Way Now Cleared for Operation of Uranium Mines of West: Vol. 58, No. 15, Apr. 17, 1947, p. 8.
[3] Mining Record, Vanadium Mill to Pay for Uranium: Vol. 58, No. 15, Apr. 17, 1947, p. 3.

mined at Conda, Idaho, and treated at Anaconda, Mont., has been consistent since 1941. The Phosphoria formation in Idaho and Wyoming contains extensive vanadium-bearing shales, but their treatment offers serious difficulties.

Utah.—The Monticello plant, operated under lease from the Defense Plant Corporation by the Vanadium Corp. of America, completed refining of the ores purchased by that company from the Office of Metals Reserve and also refined ores from other sources. The plant was shut down at the end of the year.

Reports were received by the Bureau from 14 independent mine operators who made deliveries in quantities varying up to 29,000 pounds of contained V_2O_5.

EXPLORATION AND DEVELOPMENT

The Bureau of Mines has published a report [4] describing vanadium exploration work carried out during 1943–44. The Geological Survey reported no field work and published no reports on vanadium in 1946.

CONSUMPTION AND USES

Consumption of domestic vanadium ores rose continuously from 1940 (the first year for which these data were collected) to the peak year 1943, when consumption was 2.4 times that in 1940. Since 1943 the consumption has fallen each year, and that for 1946 was 29 percent of the 1943 figure.

Vanadium is used in various forms, 90 percent as alloys (largely ferrovanadium) and 10 percent as chemical compounds (virtually entirely as fused or air-dried oxide.) By far the largest part of the vanadium consumed enters alloy steels, as is shown in the accompanying table, which presents the percentages of vanadium consumption by seven end uses.

Distribution of vanadium consumption by type of use in 1946, in percent

Use:	*Percent of total*
Steel:	
High-speed steel	52.4
Other tool steel	10.8
Other alloy steel	25.8
Deoxidation and degasification	1.5
Total steel	90.5
Nonsteel:	
Nonferrous alloys	4.8
Catalysts	3.1
Alloy cast iron	.1
Total nonsteel	8.0
Undistributed	1.5
Grand total	100.0

Vanadium stands in sharp contrast to molybdenum in that it finds slight applicability to either the stainless steels or the high temperature-high strength materials, in either this country or in England.

[4] Huleatt, W. P., Scott, W. H. Jr., and Traver, W. M. Jr., Exploration of Vanadium Region of Western Colorado and Eastern Utah; Bureau of Mines Rept. of Investigations 3930, 1946, 30 pp.

In Germany vanadium was used for these applications, apparently with considerable success. It seems probable that these German applications were dictated more by the scarcity of other alloying additives than by the superiority of vanadium.

Nonferrous alloys containing vanadium (the "Vicalloys" and "Hastelloy B" are typical) are useful for special and exacting services. Other nonsteel uses are indicated in the accompanying table.

The development of a market for vanadium chemicals is receiving attention from the Carbide and Carbon Chemicals Corp.[5]

PRICES

Vanadium ore has been quoted at 27½ cents a pound of V_2O_5 since 1935. This, however, is a quotation without regard to the grade of ore or the presence or absence of objectionable impurities—matters of importance to the refineries, inasmuch as they affect recovery vitally. The Office of Price Administration did not place vanadium ore under control at any time. Maximum prices for vanadium products established by MPR 489 are given in Minerals Yearbook, 1944 (p. 643) and remained unchanged until price control was suspended by Amendment 26 to Supplementary Order 129 on June 12, 1946.

E&MJ Metal and Mineral Markets quoted vanadium ore at 27½ cents a pound of V_2O_5 throughout 1946. Ferro-vanadium prices held at $2.75–$2.90 per pound of contained vanadium (depending upon the grade of the alloy) from January 1 until December 12, when the price changed to $2.70–$2.90, a level held throughout the remainder of the year.

FOREIGN TRADE[6]

Vanadium imports into the United States comprise ore, concentrates, dried precipitated vanadium pentoxide, and flue dust. In 1946 all ore, concentrates, and pentoxide were imported from Peru, and all the flue dust from Curaçao. The percentage of V_2O_5 in the imports from Peru was markedly higher than in 1945. The 1946 imports (measured in terms of vanadium contained) were 51 percent of those in 1945.

Vanadium ore or concentrates and vanadium-bearing flue dust imported for consumption in the United States, 1945–46, by countries

Class of material and country	1945			1946		
	Pounds		Value	Pounds		Value
	Gross weight	Vanadium content		Gross weight	Vanadium content	
Ore or concentrates: Peru	8,777,018	1,552,307	$725,666	2,784,349	791,057	$390,077
Vanadium-bearing flue dust: Curaçao (N. W. I.)	133,795	26,293	19,378	97,750	20,931	13,480

[5] Chemistry and Industry (London), Vanadium and Tungsten Compounds Being Promoted: Nos. 8, 9, 10 (one issue), Feb. 22, 1947, p. 113.

[6] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Vanadium ore or concentrates imported for consumption in the United States, 1937–46

Year	Pounds		Value	Year	Pounds		Value
	Gross weight	Vanadium content			Gross weight	Vanadium content	
1937	14,806,400	1,258,880	$638,799	1942	36,492,268	2,422,376	$1,274,483
1938	19,962,880	1,384,320	891,475	1943	22,117,131	2,052,620	1,080,150
1939	31,387,722	2,132,548	991,511	1944	4,247,490	1,284,603	633,719
1940	45,102,004	2,574,951	1,216,705	1945	8,777,018	1,552,307	725,666
1941	24,645,686	2,138,608	1,012,991	1946	2,784,349	791,057	390,077

Exports of vanadium ore and concentrates decreased from 113,927 pounds (contained vanadium) in 1945 to 6,051 pounds in 1946. Exports of ferrovanadium were 113,058 pounds (of ferro) valued at $161,289. The exports comprised 85,973 pounds to Canada, 24,240 pounds to China, 2,370 pounds to Brazil, 440 pounds to Argentina, and 35 pounds to Portugal.

Vanadium ore and concentrates [1] exported from the United States, 1944–46, by countries, in pounds

Country	1944		1945		1946 [2]
	Gross weight	Vanadium content	Gross weight	Vanadium content	Vanadium content
Canada	6,390	2,201	3,049	955	
Curaçao (N. W. I.)			13,268	3,715	
France			218,500	105,931	
India and Dependencies	9,878	4,053	8	2	
Italy					5,936
Switzerland					115
U. S. S. R.			6,767	3,324	
	16,268	6,254	241,592	113,927	6,051

[1] Classed as ore and concentrates but probably also includes fused vanadium oxide.
[2] Beginning January 1, 1946 gross weight not reported.

WORLD REVIEW

Complete data on world mine production of vanadium are lacking for 1946, but indications are that the United States has held its position as the world's largest producer. The world output in 1946 is estimated to have approximated 1,000 metric tons of contained vanadium. It must be noted, however, that the above estimate is made without considering any production in the U. S. S. R., Germany, French Morocco, and Spain, from which countries data are entirely lacking. Production in Germany for 1940–45 is unknown, but was unquestionably large, inasmuch as that country was able to substitute vanadium (recovered from the minette ores) for scarcer alloying additives.

World production of vanadium in ores and concentrates, 1938–46, in metric tons

[Compiled by B. B. Mitchell]

Country	1938	1939	1940	1941	1942	1943	1944	1945	1946
Argentina	------	15	1	6	------	------	(1)	(1)	(1)
Mexico	101	80	32	(2)	------	------	------	------	------
Northern Rhodesia	374	384	368	342	388	426	254	219	68
Peru	826	1,016	1,214	1,017	1,010	847	514	688	324
South-West Africa	557	514	428	269	453	577	385	128	100
United States (shipments)	732	900	981	1,140	2,014	2,534	1,600	1,344	577
Total [3]	2,590	2,909	3,024	2,774	3,865	4,384	2,753	2,379	1,069

[1] Data not available.
[2] Less than 1 ton.
[3] Total represents data only for countries shown in table and excludes vanadium produced in French Morocco, Spain, and U. S. S. R. and by Germany from the minette ores; accurate figures are not yet available.

Germany.—During most of World War II Germany had an internal source of vanadium, because of the special smelting methods applied to the minette ores of France, Belgium, and Luxembourg. A wartime regulation required that vanadium be recovered from known V-bearing iron ores, and an overall recovery of 50–60 percent has been reported.[7] German production of vanadium from this source is reported to have been approximately 3,000,000 pounds a year at the beginning of the war and to have increased to 6,500,000 pounds by the end.

Japan.—Japanese metallurgical practices for the production of ferroalloys have been described in detail.[8] The only vanadium-bearing materials known to exist in Japan are vanadium-bearing magnetite beach sands.

The native beach sands were processed by concentration and chemical treatment and the products reduced to ferrovanadium by the Thermit process. The ferrovanadium production of Japan is stated to have been:

Year:	*Metric tons of ferrovanadium*
1925–39	None
1940	708
1941	832
1942	533
1943	322
1944	224
1945	46
	2,665

Vanadium pentoxide was formerly imported from the United States, and ores or concentrates were brought in from Peru, Manchuria, and Mexico.

Northern Rhodesia.[9]—After a shut-down of 6 months the vanadium plant of the Broken Hill Development Co., Ltd., was reopened in March 1945. Production of fused oxide by the company has been: 1940—711 long tons; 1941—660 tons; 1942—743 tons; 1944—494 tons. Exports from Northern Rhodesia were 833 tons in 1943 and 260 tons in 1944.

[7] Colclough, T. P., German Iron and Steel Industry in the Ruhr and Salzgitter Areas: Combined Intelligence Objectives Subcommittee, Item 21, File 32-119, Office of Publication Bureau (U. S. Department of Commerce), No. 16720, 1945, 148 pp. Joint Intelligence Objectives Agency (Washington), Recovery of Vanadium from Iron and Steel Plant Slags: Rept. 23, 1945, 8 pp.
[8] Bardill, John B., The Ferroalloy Metallurgy of Japan: Bureau of Mines, Mineral Trade Notes, Supplement 14, May 1947.
[9] Bureau of Mines, Mineral Trade Notes: Vol. 22, No. 1, Jan. 20, 1946, p. 21.

South-West Africa.—The South-West Africa Co., Ltd., is the only producer of vanadium in South-West Africa. It operates the Adenab and Adenab West mines about 20 miles north of Grootfontein. The concentrates average substantially 20 percent V_2O_5. It has been announced [10] that the Otavi Mines & Railway Co., Ltd. (Otavi Minen und Eisenbahngesellschaft), has been purchased by the Tsumeb Corp. Ltd., from the Custodian of Enemy Property for £1,010,000. The O'Okiep Copper Co. and the Magma Copper Co., of America, are reported to be interested financially in the Tsumeb Corp.

Peru.—Hewett [11] has given a comprehensive account of the discovery of patronite at Mina Ragra in 1905 while he was in Peru examining the asphaltites as sources of vanadium.

[10] South African Mining and Engineering Journal, Otavi Mines Sold: Vol. 57, pt. 2, No. 2813, Jan. 11, 1947, p. 525.

[11] Hewett, D. F., The Story of Mina Ragra—Premier Vanadium Find: Eng. and Min. Jour., vol. 148, No. 1, January 1947, pp. 59–63.

Zinc[1]

By RICHARD H. MOTE AND ESTHER B. MILLER

	PAGE
General summary	1240
Salient statistics	1241
Labor problems	1241
Government regulations	1242
Tariff	1243
Domestic production	1243
Mine production	1244
Smelter production	1247
Horizontal-retort plants	1248
Vertical-retort plants	1248
Electrolytic plants	1248
Smelting capacity	1248
Waelz kilns	1248
Slag-fuming plants	1249
Active zinc-reduction plants	1249
Domestic production—Con.	
Primary and redistilled secondary slab zinc	1250
Distilled and electrolytic zinc	1250
Primary slab zinc, by States	1251
Secondary zinc	1252
Byproduct sulfuric acid	1252
Zinc dust	1252
Zinc pigments and salts	1253
Domestic consumption	1253
New supply	1253
Consumption	1254
Stocks	1256
Prices	1257
Foreign trade	1261
World review	1263

GENERAL SUMMARY

WORK stoppages due to strikes, higher operating costs, and price uncertainty when Government subsidies lapsed temporarily at midyear were major obstacles that restricted domestic zinc output in 1946. However, despite a drop in production and imports, the over-all available supply of slab zinc was sufficient to meet requirements and permit expansion of consumers' stocks.

Domestic mine production was 6 percent less than in 1945, and the outputs of primary and redistilled secondary slab zinc were 5 and 10 percent lower, respectively. The drop in domestic smelter output was partly offset, however, by an 8-percent gain in slab zinc imports, the quantity of which was the greatest in the history of the zinc industry in 1946. Imports of zinc in ores and concentrates dropped 29 percent from 1945. Year-end inventories at domestic smelters were 31 percent less than at the beginning, whereas consumers' stocks gained 28 percent over the quantity on hand at the beginning of the year.

The St. Louis quotation for Prime Western zinc averaged 8.73 cents per pound in 1946 compared with 8.25 cents in 1945.

[1] This report deals primarily with the smelting branch of the industry. Full details of zinc mining are given in the various State reports of this volume. As some zinc ore is used directly in the manufacture of zinc pigments, see also the chapter on Lead and Zinc Pigments and Zinc Salts.

Salient statistics of the zinc industry in the United States, 1925–29 (average) and 1942–46

	1925–29 (average)	1942	1943	1944	1945	1946
Production of primary slab zinc:						
By sources:						
From domestic ores.....short tons..	589,648	629,957	594,250	574,453	467,084	459,205
From foreign ores.....do....	12,734	261,915	348,059	294,849	297,477	269,057
	602,382	891,872	942,309	869,302	764,561	728,262
By methods:						
Electrolytic.....percent of total..	21	28	35	37	35	39
Distilled.....do....	79	72	65	63	65	61
Production of redistilled secondary slab zinc short tons..	43,756	53,195	48,215	49,037	49,242	44,516
Stocks on hand at primary smelters Dec. 31 short tons..	45,575	82,498	168,777	233,044	254,765	175,586
Primary zinc available for consumption short tons..	548,472	730,938	806,265	845,008	826,627	812,746
Price:						
Prime Western at St. Louis:						
Average for year.....cents per pound..	6.76	8.25	8.25	8.25	8.25	8.73
Highest quotation.....do....	8.90	8.25	8.25	8.25	8.25	10.50
Lowest quotation.....do....	5.40	8.25	8.25	8.25	8.25	8.25
Yearly average at London.....do....	6.46	4.63	4.63	4.63	5.18	7.75
Mine production of recoverable zinc short tons..	724,720	768,025	744,196	718,642	614,358	574,833
Tri-State district (Joplin)...percent of total..	49	31	27	26	23	24
Western States.....do....	30	40	43	46	48	48
Other.....do....	21	29	30	28	29	28
World smelter production of zinc..short tons..	1,435,000	1,984,200	2,017,800	1,791,500	1,404,100	1,550,400

LABOR PROBLEMS

Most significant among the many labor problems confronting operators during 1946 were the widespread strikes at principal mines, mills, smelters, and refineries that paralyzed the industry during the first half of the year. Work stoppages in 1946 began in Utah on January 21, when approximately 1,300 workers at the American Smelting & Refining Co. Murray lead smelter and the United States Smelting, Refining & Mining Co. West Mountain (Bingham) district lead-zinc mine and Midvale concentrator struck when negotiations for increased wages collapsed. Workers at certain Colorado and Arizona lead-zinc mining and milling operations of the American Smelting & Refining Co. and the Phelps Dodge Corp. joined the strike on February 25 and March 20, respectively. Lead smelters operated by the American Smelting & Refining Co. in California, Colorado, Montana, Nebraska New Jersey, and Texas also became strike-bound on February 25, and although these closures did not restrict the output of mines producing zinc alone, many zinc-lead operations were forced to close owing to limited storage facilities for ore and concentrate and insufficient capital to cover operating expenses without prompt sale of products. These strikes continued to hamper zinc mining in the West until the end of June, when new labor contracts were signed. Zinc mine production in the Eastern States was impeded by labor strikes at mines of the American Zinc Co. of Tennessee in Knox and Jefferson Counties, Tenn., from February 2 through May 4 and at mines of the New Jersey Zinc Co. in New Jersey from mid-June to August 17.

Labor strikes at zinc smelters at East St. Louis and Monsanto, Ill., restricted production in January, and a complete shut-down of the smelter at Danville, Ill., in March stopped production for the remain-

der of the year. The Henryetta, Okla., smelter closed in early April owing to strike conditions and did not resume operations until the latter part of September. In Pennsylvania, a strike stopped production at the Langeloth smelter from June to October, and a shortage of electrical power due to a labor strike curtailed output at the Josephtown smelter in October.

The shortage of mine and mill labor continued to be a potent factor limiting domestic mine output during 1946. The predicted return to the mines of former employees who migrated to the cities for high-paying wartime jobs fell far short of expectations. Likewise, a large percentage of the labor supply that entered the armed services during the war did not return upon demobilization; however, most operators considered that the manpower supply problem had improved somewhat by the end of 1946.

GOVERNMENT REGULATIONS

Except for a few minor regulations, the zinc industry operated throughout 1946 free of Government controls. At the end of the year Priorities Regulation 32 limiting manufacturers' inventories of all grades of slab zinc and die-cast alloy to 30 days' requirements or a practicable working inventory, whichever is less, remained operative. Regulations requiring a license for exporting slab zinc and zinc semimanufactures to certain countries also remained operative during the year. Consumers requesting zinc supplies from the Reconstruction Finance Corporation reserve stocks were required to file proof of necessity.

Subsidy payments under the Premium Price Plan for over-quota production were continued through June but collapsed with expiration of Office of Price Administration and ceiling prices June 30. Upon reestablishment of the OPA, provisions were made for retroactive premium payments to cover the period when no plan was in effect.

The establishment of a Federal Government stock pile of strategic minerals and metals for national defense was authorized on July 23 when President Truman signed the Strategic and Critical Materials Stock-piling Act (Public Law 520, 79th Congress). The act authorizes and directs the Secretary of War, the Secretary of the Navy, and the Secretary of the Interior, acting jointly through the agency of the Army and Navy Munitions Board, to determine from time to time what materials are strategic, and to establish quantities and dates for stock piling. The act further provides that purchases for stock piling shall be made from supplies in excess of current industrial demand and at a price not to exceed current open market price. Except to provide for the rotation of any stock-piled material where necessary to prevent deterioration, no disposition of stock-piled material shall be made without 6 months' public notice and congressional approval. The President, however, may order the release of stock-piled materials when required for purposes of the common defense or in time of war or national emergency.

Figure 1 shows trends in the domestic zinc industry in the United States since 1900.

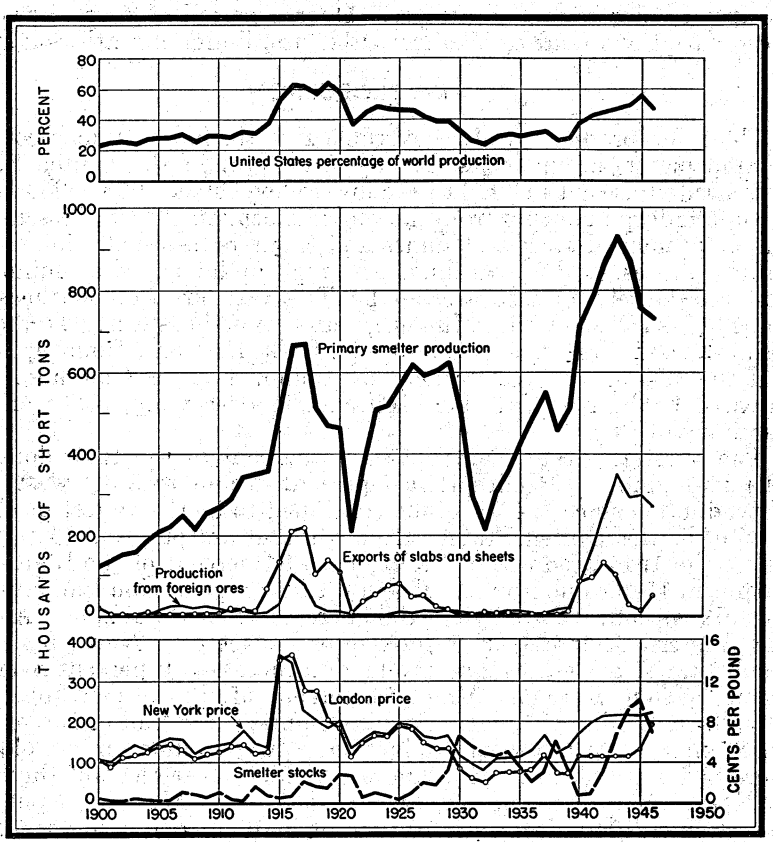

FIGURE 1.—Trends in the zinc industry in the United States 1900–46. Imports for consumption of slab and sheet zinc are not shown. Before 1936 they seldom exceeded 500 tons annually, but in recent years they have increased, amounting to 36,402 tons in 1942, 56,155 tons in 1943, 63,641 tons in 1944, 96,710 tons in 1945, and 104,015 tons in 1946.

TARIFF

The import tariff on zinc-bearing ores remained at ¾ cent per pound (zinc content) and on zinc in blocks, pigs or slabs, and dust at ⅞ cent per pound during 1946.

DOMESTIC PRODUCTION

Zinc-production statistics may be prepared on a mine or on a smelter basis. The mine-production data compiled on a basis of zinc content in ores and concentrates and adjusted to account for average losses in smelting are the most accurate measure of output from year to year. The slab-zinc production, as reported by smelters, presents a more precise figure of actual zinc recovery but generally differs from the mine figure owing to overlap or lag between mine shipments and smelter

receipts of ores and concentrates. Over a period of years, however, these variations tend to balance within the limits of statistical error.

MINE PRODUCTION

The mine production of recoverable zinc (including that recovered as zinc pigments and salts directly from ore) in the United States decreased 6 percent in 1946 to the lowest level since 1938. The uninterrupted drop in output from the wartime peak in 1942 was essentially due to prolonged strikes at mines and smelters, especially in western United States, and a continued shortage of labor. Zinc mining is centered largely in five areas—the Tri-State area of southeastern Kansas, southwestern Missouri, and northeastern Oklahoma; Tennessee-Virginia; Sussex County, N. J.; St. Lawrence County, N. Y.; and the Western States (principally Idaho, Arizona, Colorado, New Mexico, Utah, Nevada, and Montana, in descending order of productivity in 1946).

The Western States contributed 48 percent of the total domestic output of zinc in 1946 despite a 7-percent decline to the lowest level of production since 1940. Idaho continued to be the largest producer of zinc in the United States, although 1946 output was 14 percent below the 1945 production. More than 94 percent of the Idaho zinc output in 1946 came from the Coeur d'Alene region; zinc-lead ores and old tailings concentrated yielded 85 percent of the total zinc. Among the Western States, Arizona took second place over New Mexico by a substantial margin as zinc production increased 9 percent over the record output of 1945. About 51 percent of the Arizona total zinc came from a mine at Bisbee, Cochise County; zinc-lead ore accounted for 87 percent of the total production. Zinc production in Colorado increased 1 percent in 1946; zinc ore yielded 53 percent of the State total zinc and zinc-lead ore, 38 percent. New Mexico output, the lowest since 1940, decreased 10 percent in 1946 compared with 1945. Over 89 percent of the total output came from mines in the Central district, Grant County; zinc ore yielded 91 percent of the total zinc produced. Utah zinc output slumped 16 percent to the lowest level since 1934. Owing to a 5-month labor strike at the United States and Lark group, production of zinc in the West Mountain (Bingham) district—for years the leading source of zinc in Utah—declined to about half that in 1945, permitting the Park City region to advance to first place. Zinc-lead ore concentrated supplied 79 percent of the total zinc in 1946, and zinc slag fumed most of the remainder. Production of zinc in Nevada in 1946 was the greatest in the history of the State. About 70 percent of the total was mined in the Pioche district, Lincoln County; nearly 92 percent of the zinc recovered was from zinc-lead ore. The mine output of zinc in Montana declined 4 percent in 1946; zinc-lead ore accounted for 65 percent of Montana's zinc in 1946, and 34 percent was from zinc ore and old slag.

Zinc production in the Central States, smallest since 1933, decreased 1 percent from the 1945 output. The Tri-State (Joplin) region maintained its position as the principal zinc-producing district, with 24 percent (23 percent in 1945) of the total United States output.

Mine production of recoverable zinc in the United States, 1925–29 (average) and 1942–46, by States, in short tons

State	1925–29 (average)	1942	1943	1944	1945	1946
Western States:						
Arizona	2,628	18,522	19,677	29,077	40,226	43,665
California	3,999	613	1,856	8,455	9,923	6,877
Colorado	32,868	32,215	44,094	39,955	35,773	36,147
Idaho	29,128	87,256	86,707	91,372	83,463	71,507
Montana	72,519	54,715	37,606	36,127	17,403	16,770
Nevada	5,570	10,197	13,647	20,699	21,457	22,649
New Mexico	23,351	46,461	59,524	50,727	40,295	36,103
Oregon					1	
South Dakota		115	46	56		
Texas						44
Utah	44,385	45,543	46,896	38,994	33,630	28,292
Washington	575	14,398	12,203	11,904	11,693	11,329
	215,023	310,035	322,256	327,366	293,864	273,383
Central States:						
Arkansas	71	181	96	19	303	85
Illinois	1,174	9,389	5,851	7,262	8,310	8,798
Kansas	114,323	55,874	56,944	63,703	48,394	47,703
Kentucky	644	407	931	341	182	314
Missouri	16,708	36,394	30,413	36,626	22,175	22,234
Oklahoma	226,969	146,510	114,085	91,449	69,300	69,552
Wisconsin	23,055	9,426	14,387	15,549	15,561	14,276
	382,944	258,181	222,707	214,949	164,225	162,962
Eastern States:						
New Jersey	93,839	94,040	92,864	80,288	81,392	64,454
New York	7,091	45,807	46,000	35,541	24,978	32,515
Tennessee	14,631	43,971	41,766	40,831	33,824	24,614
Virginia	11,192	15,991	18,603	19,667	16,075	16,905
	126,753	199,809	199,233	176,327	156,269	138,488
	724,720	768,025	744,196	718,642	614,358	574,833

Despite a decline of 11 percent in zinc production due largely to a sharp drop in the output from New Jersey, the Eastern States contributed 24 percent of the total domestic output.

Mine production [1] of recoverable zinc in the United States, 1941–46, by months, in short tons

Month	1941	1942	1943	1944	1945	1946
January	60,833	67,289	58,798	66,304	56,745	51,870
February	55,627	63,684	55,634	65,253	50,901	47,968
March	61,184	69,415	62,540	68,219	56,344	51,177
April	62,555	68,521	66,072	64,496	51,663	47,972
May	61,852	68,871	59,620	63,292	54,084	48,655
June	64,030	64,540	60,626	59,648	52,429	42,966
July	60,950	63,253	60,036	56,710	47,686	33,737
August	63,973	61,671	61,423	60,259	46,694	46,567
September	63,453	57,702	63,621	53,362	47,664	49,030
October	65,284	61,164	64,999	54,293	52,029	52,191
November	62,038	58,892	66,652	54,527	51,515	50,574
December	67,346	63,023	64,175	52,279	46,604	52,126
	749,125	768,025	744,196	718,642	614,358	574,833

[1] Monthly data for 1941–44 were based largely on smelter receipts, whereas those for 1945 and 1946 represent actual mine output. All monthly figures have been adjusted to final annual mine-production totals.

The 25 leading zinc-producing mines in the United States in 1946, listed in the following table, yielded 49 percent of the total domestic zinc output.

Twenty-five leading zinc-producing mines in the United States in 1946, in order of output

Rank	Mine	District	State	Operator	Type of ore
1	Franklin & Sterling Hill	New Jersey	New Jersey	New Jersey Zinc Co	Zinc.
2	Copper Queen	Warren (Bisbee)	Arizona	Phelps Dodge Corp	Zinc-lead.
3	Balmat	St. Lawrence County	New York	St. Joseph Lead Co	Do.
4	Austinville	Austinville	Virginia	New Jersey Zinc Co	Do.
5	Eagle	Red Cliff	Colorado	Empire Zinc Division, New Jersey Zinc Co	Zinc.
6	Bayard Mine group	Central	New Mexico	U. S. Smelting, Refining & Mining Co	Do.
7	Star	Hunter	Idaho	Sullivan Mining Co	Zinc-lead.
8	Bunker Hill Smelter Slag Dump	Yreka	do	Bunker Hill & Sullivan Mining & Concentrating Co	Zinc slag.
9	Edwards	St. Lawrence County	New York	St. Joseph Lead Co	Zinc.
10	Osburn Tailings	Evolution	Idaho	Hecla Mining Co	Zinc-lead.
11	Combined Metals group	Pioche	Nevada	Combined Metals Reduction Co., & R. E. West Mining Co.	Do.
12	Page	Yreka	Idaho	Federal Mining & Smelting Co	Do.
13	Davis-Bible group	Eastern Tennessee	Tennessee	Universal Exploration Co	Zinc.
14	United States & Lark	West Mountain	Utah	U. S. Smelting, Refining, & Mining Co	Zinc-lead.
15	Mascot No. 2 and Mascot Graves	Eastern Tennessee	Tennessee	American Zinc Co. of Tennessee	Zinc.
16	Ely Valley	Pioche	Nevada	Ely Valley Mine	Zinc-lead.
17	Hanover Mine group	Central	New Mexico	Empire Zinc Division, New Jersey Zinc Co	Zinc.
18	Paxson-Stoskopt Swalley "D" group	Tri-State	Kansas	Eagle-Picher Mining & Smelting Co	Zinc-lead.
19	Grasselli	Eastern Tennessee	Tennessee	American Zinc Co. of Tennessee	Zinc.
20	Iron King	Big Bug	Arizona	Shattuck Denn Mining Corp	Zinc-lead.
21	Smelter slag dump	Smelter	Montana	American Smelting & Refining Co	Zinc-slag.
22	Tooele Zinc Fume Plant	Smelter	Utah	International Smelting & Refining Co	Do.
23	Park Galena & Mayflower	Blue Ledge	do	New Park Mining Co	Zinc-lead.
24	Oswaldo	Central	New Mexico	Kennecott Copper Corp	Zinc.
25	Morning	Hunter	Idaho	Federal Mining & Smelting Co	Zinc-lead.

Detailed information on the production of mines and districts in the United States may be found in the chapters of this volume dealing with the mine production of gold, silver, lead, and zinc in the various States.

Mine production of recoverable zinc in the United States, by districts that produced 1,000 tons or more during any year, 1942–46, in short tons

District	State	1942	1943	1944	1945	1946
Tri-State (Joplin region)	Kansas, southwestern Missouri, Oklahoma.	237,936	200,514	190,270	139,274	139,038
Coeur d'Alene region	Idaho	78,313	79,634	85,227	78,030	67,429
New Jersey	New Jersey	94,040	92,864	80,288	81,392	64,454
St. Lawrence County	New York	45,807	46,000	35,541	24,978	32,515
Central	New Mexico	42,374	52,215	44,648	36,245	32,279
Eastern Tennessee [1]	Tennessee	43,971	41,766	40,831	33,824	24,614
Warren (Bisbee)	Arizona	1,449	1,020	8,070	18,078	22,374
Upper Mississippi Valley	Iowa, northern Illinois, Wisconsin.	11,126	15,539	17,242	19,318	18,344
Austinville	Virginia	15,793	17,139	18,257	16,000	16,905
Red Cliff	Colorado	22,880	28,854	20,492	15,805	16,437
Pioche	Nevada	8,957	11,991	17,983	16,575	15,764
Park City region	Utah	13,026	11,487	9,556	7,435	8,876
Metaline	Washington	13,620	9,292	9,236	7,794	7,685
West Mountain (Bingham)	Utah	22,634	23,405	19,151	14,670	7,593
Summit Valley (Butte)	Montana	29,313	7,877	7,874	8,364	7,108
California (Leadville)	Colorado	3,344	5,512	7,984	7,419	5,996
Big Bug	Arizona	2,650	3,009	3,794	4,922	5,234
Kentucky-Southern Illinois	Kentucky, southern Illinois	8,096	5,630	5,910	4,735	5,044
Smelter (Lewis and Clark County).	Montana	20,190	24,165	20,623	2,235	4,995
Smelter (Tooele County)	Utah	[2]	[2]	[2]	[2]	[2]
Old Hat (Oracle)	Arizona	579	2,450	2,521	4,750	4,235
Pima (Sierritas, Papago, Twin Buttes).	do	------	1,390	5,170	3,697	3,948
Tintic	Utah	1,708	2,330	3,450	2,928	3,710
Eureka	Nevada	------	40	195	1,204	3,705
Magdalena	New Mexico	3,185	5,290	4,474	3,044	3,474
Pioneer (Rico)	Colorado	2,764	3,652	4,557	3,920	3,435
Campo Seco	California	------	------	712	2,134	3,301
Cochise	Arizona	284	------	46	1,300	2,877
Ten Mile	Colorado	643	971	1,483	2,142	2,490
Warm Springs	Idaho	6,260	4,740	4,000	2,797	2,161
Upper San Miguel	Colorado	390	1,213	828	1,458	1,963
Flat Creek	California	------	229	1,532	1,714	1,926
Northport	Washington	685	914	1,438	1,410	1,790
Chelan Lake	do	------	1,930	1,074	2,419	1,730
Animas	Colorado	379	474	577	795	1,590
Heddleston	Montana	1,266	953	1,529	1,878	1,516
Rush Valley	Utah	[2]	[2]	[2]	[2]	[2]
Harshaw	Arizona	4,825	3,398	2,051	1,666	1,128
Breckenridge	Colorado	------	231	318	723	1,110
Patagonia	Arizona	1,913	1,931	1,261	683	833
Sheridan	Montana	139	519	1,053	861	785
Wallapai	Arizona	2,244	1,542	1,046	684	486
Hunter Valley	California	------	------	3,346	3,311	------
Pioneer (Superior)	Arizona	3,884	4,072	3,850	2,297	------
Yankee Hill	California	------	407	1,444	1,251	------
South Mountain	Idaho	1,485	633	696	678	------
Packer Creek	Montana	------	1,001	1,389	254	------
Livingston	Virginia	198	1,456	1,410	75	------

[1] Includes very small quantity produced elsewhere in State.
[2] Bureau of Mines not at liberty to publish.

SMELTER PRODUCTION

During 1946, 21 primary zinc-reduction plants were in operation, of which 12 operated with horizontal retorts exclusively, 1 with both horizontal and vertical retorts, 3 with vertical retorts exclusively (one electrothermic), and 5 with electrolytic methods.

The St. Joseph Lead Co. continued experimental operation of its slag-fuming plant at Herculaneum, Mo., in 1946 for the recovery of

slab zinc as a direct product of the operation that treats lead blast-furnace slag containing 12 to 16 percent zinc.

Horizontal-Retort Plants.—The total number of retorts reported at active horizontal-retort primary plants in 1946 was 73,240, a 1-percent decrease from the 74,120 retorts on December 31, 1945, at plants which operated during that year. Of the total retorts reported, 54,272 (74 percent) were in use at the close of 1946, compared with 54,932 (74 percent) in operation at the end of 1945.

Vertical-Retort Plants.—Four vertical-retort continuous distilling plants operated during 1946. The St. Joseph Lead Co. operated its 9 electrothermic units at Josephtown, Pa., at about 90 percent capacity throughout the year. Of the 66 vertical retorts at the remaining 3 plants, 62 were in operation on December 31, 1946.

Electrolytic Plants.—Five electrolytic plants were in operation during 1946, as in 1945. There were 3,670 cells at the plants on December 31, 1946, of which 3,128 (85 percent) were in operation compared with 3,184 (99 percent) at the end of 1945. No new installations were reported under construction or planned.

Smelting Capacity.—Irrespective of additions or subtractions of smelter recovery units, statistics on domestic smelting capacity vary from year to year owing to changes in metallurgical practices among the various plants. According to reports to the Bureau of Mines, the zinc-reduction plants in the United States on December 31, 1946, had a stated annual capacity to produce 1,067,800 tons of slab zinc under normal operating conditions, allowing for necessary shut-downs for repairs. This figure, which compares with a 1,054,000-ton reported capacity at the end of 1945, indicates that the 1946 output was 72 percent of the capacity as compared with 77 percent in 1945. Horizontal- and vertical-retort plants operated at 73 percent of a stated 641,000-ton capacity (77 percent of a 672,000-ton capacity in 1945), electrolytic plants at 74 percent of a 382,400-ton capacity (80 percent in 1945), and secondary smelters at 59 percent of a 44,400-ton capacity (64 percent of a 44,000-ton capacity in 1945).

No additional smelting capacity was planned at the end of 1946, and only a small increase of four graphite retorts was under construction at one smelter.

Waelz Kilns.—Waelz plants have been installed in recent years at several midwestern and eastern smelters to facilitate recovery of additional metals from the ore and to reduce over-all smelting losses. The following companies operated Waelz kilns in 1946:

Arkansas:
- Fort Smith—The Residue Co.

Illinois:
- Fairmont City—American zinc Co. of Illinois.
- Danville—The Hegeler Zinc Co.
- La Salle—Matthiessen & Hegeler Zinc Co.

Kansas:
- Cherryvale—National Zinc Co., Inc.

Oklahoma:
- Henryetta—Eagle-Picher Mining & Smelting Co.

Pennsylvania:
- Donora—American Steel & Wire Co.
- Langeloth—American Zinc & Chemical Co.
- Palmerton—New Jersey Zinc Co.

Slag-Fuming Plants.—The recovery of zinc from lead smelting slags has become an increasingly important source of zinc in the United States in recent years. In the slag-fuming process zinc is recovered in the form of oxidized zinc fume from hot slags of lead blast furnaces and reclaimed dump slags from old lead smelter slag accumulations. The oxidized zinc fume is further treated at electrolytic and horizontal retort zinc smelters for recovery of metallic zinc. The following companies operated slag-fuming plants in 1946:

Idaho:
Bradley—Bunker Hill & Sullivan Mining & Concentrating Co.
Montana:
East Helena—Anaconda Copper Mining Co.
Utah:
Tooele—International Smelting & Refining Co.

In 1946, the three plants in the United States treated 486,428 tons of hot and cold slag, which yielded 75,385 tons of oxide fume containing 41,566 tons of recoverable zinc.

The American Smelting & Refining Co. completed plans in 1946 for the construction of a slag-fuming plant to recover zinc from slag at the company El Paso (Texas) smelter. Construction on the project was begun early in 1947.

Active Zinc-Reduction Plants.—A list of the zinc-reduction plants operating in the United States in 1946 follows:

Horizontal-retort plants

Arkansas:
Fort Smith—Athletic Mining & Smelting Co.
Van Buren—Arkansas Smelting Co.[2]
Illinois:
Fairmont City—American Zinc Co. of Illinois.
Danville—The Hegeler Zinc Co.
La Salle—Matthiessen & Hegeler Zinc Co.
Oklahoma:
Blackwell—Blackwell Zinc Co.
Henryetta—Eagle-Picher Mining & Smelting Co.
Bartlesville—National Zinc Co., Inc.
Pennsylvania:
Langeloth—American Zinc & Chemical Co.
Donora—American Steel & Wire Co.
Palmerton—The New Jersey Zinc Co. of Pennsylvania.
Texas:
Amarillo—American Smelting & Refining Co.
Dumas—American Zinc Co. of Illinois.

Vertical-retort plants

Illinois:
Dupue—The New Jersey Zinc Co.
Pennsylvania:
Palmerton—The New Jersey Zinc Co. of Pennsylvania.
Josephtown—St. Joseph Lead Co.
West Virginia:
Meadowbrook—E. I. du Pont de Nemours & Co.

Electrolytic plants

Idaho:
Kellogg—Sullivan Mining Co.
Illinois:
East St. Louis—American Zinc Co. of Illinois.
Montana:
Anaconda—Anaconda Copper Mining Co.
Great Falls—Anaconda Copper Mining Co.
Texas:
Corpus Christi—American Smelting & Refining Co.

[2] Operations suspended January 1946.

PRIMARY AND REDISTILLED SECONDARY SLAB ZINC

The output of primary slab zinc in 1946, the smallest since 1940, dropped 5 percent below the 1945 production. Although the use of foreign ore declined and the slab zinc produced from this source dropped 10 percent, the quantity of zinc recovered from foreign ore continued high in comparison with prewar years. Production from domestic ore, lowest since 1938, declined 2 percent to continue the downward trend in evidence since 1941.

Production of redistilled slab zinc from zinc scrap declined 10 percent in 1946. Of the 44,516 short tons of redistilled secondary slab zinc produced, 18,408 tons (41 percent) were derived from primary smelters, and 26,108 tons (59 percent) were produced at secondary plants. Data on the output of remelted secondary slab zinc are not included with those for redistilled metal. In 1946 the production of slab zinc recovered by remelting purchased scrap amounted to 8,212 tons (8,090 tons in 1945). Zinc rolling mills and other consumers of slab zinc recover large quantities of zinc from their own plant scrap; but such metal is not measured statistically, for it normally does not enter the market as scrap.

Primary and redistilled secondary slab zinc produced in the United States, 1942–46, in short tons

Year	Primary			Redistilled secondary	Total (excludes zinc recovered by remelting)
	Domestic	Foreign	Total		
1942	629,957	[1] 261,915	891,872	53,195	945,067
1943	594,250	[1] 348,059	942,309	48,215	990,524
1944	574,453	[1] 294,849	869,302	49,037	918,339
1945	467,084	[1] 297,477	764,561	49,242	813,803
1946	459,205	269,057	728,262	44,516	772,778

[1] Includes a small tonnage of foreign slab zinc further refined into high-grade metal in the United States.

DISTILLED AND ELECTROLYTIC ZINC

Of the 1946 output of primary zinc, 61 percent was distilled and 39 percent was produced electrolytically compared with 65 and 35 percent, respectively, in 1945.

An increased demand for zinc for alloy die-casting was largely the cause for the gain in output of Special High Grade zinc, the only grade of slab zinc in which production increased in 1946. In contrast to a 7-percent rise in output of Special High Grade, Regular (Ordinary) High Grade decreased 6 percent, Intermediate 34 percent, Selected 21 percent, and Prime Western 10 percent. Production of Brass Special remained virtually unchanged. The original first-stage smelter production of Prime Western zinc was somewhat higher than is indicated in the following table, but to avoid duplication the quantity consumed in redistilling was omitted because the resultant Special High Grade slab zinc thus produced is reported. Of the total 1946 production (comparable 1945 figures in parentheses), 30 percent (32 percent) was Prime Western, 31 percent (27 percent) Special High Grade, 23 percent (24 percent) Regular High Grade, 10 percent (9 percent) Brass Special, 4 percent (6 percent) Intermediate, and 2 percent (2 percent) Selected.

Distilled and electrolytic zinc, primary and secondary, produced in the United States, 1942–46, in short tons

CLASSIFIED ACCORDING TO METHOD OF REDUCTION

Year	Electrolytic primary	Distilled	Redistilled secondary [1]		Total
			At primary smelters	At secondary smelters	
1942	252,987	638,885	20,978	32,217	945,067
1943	329,902	612,407	24,385	23,830	990,524
1944	317,388	551,914	24,673	24,364	918,339
1945	269,924	494,637	21,205	28,037	813,803
1946	281,295	446,967	18,408	26,108	772,778

CLASSIFIED ACCORDING TO GRADE

Year	Grade A		Grade B (Intermediate)	Grades C and D		Grade E (Prime Western)	Total
	Special High Grade (99.99% Zn)	Regular High Grade (Ordinary)		Brass Special	Selected		
1942	231,422	250,501	77,527	86,176	26,800	272,641	945,067
1943	293,168	303,743	62,700	82,072	20,445	228,396	990,524
1944	251,210	251,595	55,928	54,396	24,396	280,814	918,339
1945	220,241	191,639	49,106	75,749	17,367	259,701	813,803
1946	236,184	180,366	32,294	75,296	13,697	234,941	772,778

[1] For total production of secondary zinc see chapter on Secondary Metals—Nonferrous.

PRIMARY SLAB ZINC, BY STATES

Montana was the leading producer of primary slab zinc in 1946. Pennsylvania, which displaced Montana for first place in 1945, ranked second in 1946 and was followed by Oklahoma. Of the States for which production figures may be released, Illinois, Idaho, and Arkansas occupied the next three positions, in order of decreasing importance. Montana and Idaho, as usual, produced electrolytic zinc only, Illinois and Texas made both electrolytic and distilled metal, and all other States confined their operations to distillation alone.

Some indication of the movement of foreign ores and concentrates within the United States is revealed when a break-down of the production of primary slab zinc from this source is considered. Of the 269,057 tons of primary slab zinc of foreign origin recovered in 1946, smelters in Montana accounted for 29 percent, Pennsylvania 21 percent, Oklahoma 17 percent, Illinois 13 percent, Texas 11 percent, West Virginia, Arkansas, and Idaho combined 9 percent. Of the total slab zinc produced from foreign ores and concentrates, 46 percent was recovered by electrolytic methods and 54 percent by distillation.

Primary slab zinc produced in the United States, by States where smelted, 1942–46, in short tons

Year	Arkansas	Idaho	Illinois	Montana	Oklahoma	Pennsylvania	Other States [1]	Total	
								Short tons	Value
1942	41,649	39,916	175,455	193,486	102,422	231,362	107,582	891,872	$155,186,000
1943	35,704	41,129	221,680	237,585	72,043	218,058	116,110	942,309	162,076,000
1944	31,350	36,562	155,362	224,391	107,364	206,315	107,958	869,302	149,520,000
1945	29,391	33,110	124,904	179,251	106,115	200,709	91,081	764,561	131,504,492
1946	18,720	34,832	104,002	186,662	104,125	178,811	101,110	728,262	129,630,636

[1] Texas and West Virginia; also Missouri in 1943 and 1944.

SECONDARY ZINC

In addition to the redistilled secondary slab zinc (unalloyed) already reported herein, some remelted slab zinc is produced, and a large quantity of secondary zinc is recovered each year in the form of alloys, zinc dust, zinc pigments, and zinc salts. Additional information on secondary zinc is given in the Secondary Metals—Nonferrous chapter of this volume.

BYPRODUCT SULFURIC ACID

Sulfuric acid made from the sulfur dioxide gases produced in roasting zinc blende (sphalerite) is an important byproduct of zinc smelting. To utilize a larger proportion of their acid-producing capacity, some plants also consume large quantities of native sulfur. The production of sulfuric acid at zinc-blende roasting plants decreased 17 percent in 1946.

Sulfuric acid (60° B. basis) made at zinc-blende roasting plants in the United States, 1942–46

Year	Made from zinc blende [1]		Made from native sulfur		Total [1]		
	Short tons	Value [2]	Short tons	Value [2]	Short tons	Value [2]	
						Total	Average per ton
1942	695,242	$6,570,037	147,513	$1,393,998	842,755	$7,964,035	$9.45
1943	879,266	8,687,148	155,210	1,533,475	1,034,476	10,220,623	9.88
1944	839,451	8,344,143	258,927	2,573,734	1,098,378	10,917,877	9.94
1945	786,582	7,944,478	303,327	3,063,603	1,089,909	11,008,081	10.10
1946	701,080	6,842,541	207,141	2,021,696	908,221	8,864,237	9.76

[1] Includes acid from foreign blende.
[2] At average of sales of 60° acid.

ZINC DUST

All previous records for production of zinc dust were broken in 1946, the total output being 10 percent greater than in 1945 and 8 percent above the former high point reached in 1944. Zinc powder and blue powder are not included in the total produced; the zinc dust statistically reported is restricted to commercial grades that comply with severe specifications as to percentage of unoxidized metal, evenness of grading, and fineness of particles. The zinc content of the dust produced in 1946 ranged from 94.97 to 99.69 percent and averaged 97.91 percent. Shipments of zinc dust totaled 27,257 tons, of which 1 percent went to foreign countries. Shipments of zinc dust were slightly lower than production, and as the quantity consumed at manufacturers' plants was small (3 percent of output), producers' stocks increased from 1,622 tons (corrected figure) at the beginning to 2,148 tons at the close of the year.

The average price of zinc dust shipped to domestic consumers in 1946 was 10.6 cents a pound compared with 10.1 cents in 1945. The raw materials used to manufacture zinc dust are reviewed in the Secondary Metals—Nonferrous chapter of this volume. Most of the production is from zinc scrap (principally galvanizers' dross), but some is recovered from zinc ore, slab zinc, and as a byproduct of zinc refining.

Zinc dust [1] produced in the United States, 1942–46

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average per pound			Total	Average per pound
1942	22,805	$4,789,050	$0.105	1945	25,877	$5,227,154	$0.101
1943	25,990	5,249,980	.101	1946	28,574	6,057,688	.106
1944	26,511	5,408,244	.102				

[1] All produced by distillation.

ZINC PIGMENTS AND SALTS

The principal zinc pigments are zinc oxide and lithopone, and the principal salts are the chloride and sulfate. These products are manufactured from various zinc-bearing materials, including ore, metal, scrap, and residues. Details of the production of zinc pigments and salts are given in the Lead and Zinc Pigments and Zinc Salts chapter of this volume.

DOMESTIC CONSUMPTION

NEW SUPPLY

The following table shows the 5-year record of primary slab zinc available for consumption in the United States. This calculated quantity, in effect, is equivalent to primary slab zinc apparently made available each year for shipment to domestic consumers during the year.

In addition to primary slab zinc, 45,213 tons of redistilled secondary slab zinc were made available to consumers in 1946, after allowance for a decrease in stocks at secondary smelters. Also 8,212 tons of remelt spelter were produced from purchased scrap.

Primary slab zinc available for consumption in the United States, 1942–46, in short tons

	1942	1943	1944	1945	1946
Supply:					
Stocks at smelters Jan. 1	24,212	82,498	168,777	233,044	254,765
Production	[1] 886,810	[1] 933,828	[1] 867,225	[1] 764,316	728,262
Imports	36,352	56,155	63,626	97,116	104,743
Total available	947,374	1,072,481	1,099,628	1,094,476	1,087,770
Withdrawn:					
Exports	133,938	97,439	21,576	7,782	37,431
Shipments for Government account				5,302	62,007
Stocks at smelters Dec. 31	82,498	168,777	233,044	254,765	175,586
Total withdrawn	216,436	266,216	254,620	267,849	275,024
Available for consumption	730,938	806,265	845,008	826,627	812,746

[1] Adjusted to exclude imported slab zinc further refined into high-grade metal in the United States.

CONSUMPTION [3]

According to reports from plants representing an estimated 99 percent of the consuming industry in the United States (670 plants in 1946), 801,242 tons of slab zinc (including 3,912 tons of purchased remelt spelter) were put in process in 1946, a 6-percent decline from the 1945 total of 852,311 tons and 10 percent below the record level of 888,626 tons in 1944. Receipts at consumers' plants during 1946 were 821,930 tons. The apparent discrepancy between this figure and the calculated 866,171 tons of primary and secondary slab zinc and remelt spelter shipped to domestic consumers in 1946 can be attributed to incomplete coverage of the survey, variations in the quantity of metal in transit from producer to consumer at the beginning and the end of the year, and unaccounted-for slab zinc stored in bonded warehouses.

Galvanizing continued as the principal use of slab zinc, although the quantity consumed for this purpose in 1946 declined 5 percent. The use of slab zinc fell sharply, owing largely to labor strikes at the brass mills and the increasing use of brass scrap in lieu of virgin metal. The quantity of zinc used for zinc-base alloys reached an all-time high of 212,211 tons, a gain of 62 percent over 1945.

Consumption of slab zinc in the United States, 1942–46, by industries, in short tons [1]

Industry and product	1942	1943	1944	1945	1946
Galvanizing: [2]					
Sheet and strip	76,106	72,233	119,381	135,383	113,816
Wire and wire rope	35,216	37,391	44,350	46,083	43,667
Tubes and pipe	47,085	51,023	50,472	63,163	62,460
Wire cloth	7,320	(3)	(3)	(3)	(3)
Fittings	(3)	14,549	14,113	10,014	10,593
Other [4]	81,764	78,005	87,675	82,538	89,223
	247,491	253,201	315,991	337,181	319,759
Brass products:					
Sheet, strip, and plate	292,820	287,962	246,402	146,375	66,125
Rod and wire		66,538	70,970	67,299	53,387
Tube		24,456	27,725	21,507	19,173
Castings and billets	27,126	16,851	16,703	12,942	4,776
Copper-base ingots		20,384	17,174	9,893	4,379
Other copper-base products		2,888	2,953	1,361	1,262
	319,946	419,079	381,927	259,377	149,102
Zinc-base alloy:					
Die castings	58,918	60,115	76,201	121,966	206,237
Alloy dies and rod	21,227	16,067	8,245	8,286	5,313
Slush and sand castings	(5)	143	75	584	661
	80,145	76,325	84,521	130,836	212,211
Rolled zinc	66,045	48,529	76,524	97,589	92,397
Zinc oxide	7,977	11,496	20,198	18,113	19,170
Other uses:					
Slush castings	552	(6)	(6)	(6)	(6)
Wet batteries	1,667	1,807	2,174	1,790	1,635
Desilverizing lead	1,251	2,178	2,051	2,095	1,781
Light-metal alloys	(3)	1,074	2,047	1,469	545
Other [7]	3,095	3,088	3,193	3,861	4,642
	6,565	8,147	9,465	9,215	8,603
Total consumption	728,169	816,777	[8] 888,626	[8] 852,311	[8] 801,242

[1] Based of a canvass of 600 plants in 1942 and a somewhat larger coverage in 1943–46 mostly from small consumers.
[2] Includes zinc used in electrogalvanizing, but excludes sherardizing.
[3] Separate figures not available but included in "Other."
[4] Includes miscellaneous articles not given elsewhere.
[5] Included under "Other uses."
[6] Included under "Zinc-base alloy" in 1943–46.
[7] Includes zinc used in making zinc dust, bronze powder, alloys, chemicals, castings, and miscellaneous uses not elsewhere mentioned.
[8] Includes 6,982 tons of remelt zinc in 1944, 5,111 tons in 1945, and 3,912 tons in 1946.

[3] See also, Ransome, Alfred L., Consumption of Slab Zinc in the United States, 1900–45, by Industries, Grades and Geographic Divisions: Bureau of Mines Inf. Circ. 7450, February 1948, 31 pp.

The volume of slab zinc consumed for rolled products fell 5 percent short of equaling the 1945 figure. In addition to slab zinc, the rolling mills remelt and reroll the metallic scrap produced from their fabricating operations. The scrap so treated in 1946 amounted to 18,670 tons—a 42-percent decrease from the comparable total processed in 1945. Purchased zinc scrap in the form of zinc clippings, old zinc scrap, and engravers' plates totaling 3,313 tons were melted and rolled in 1946 (3,652 tons in 1945). Production of rolled zinc from slab zinc and purchased scrap was 92,648 tons, a decrease of 6 percent from the total for 1945. Inventories of rolled zinc were 2,556 tons on December 31, 1946, compared with 2,498 tons (revised figure) on the same date in 1945. In addition to the actual shipments of 61,128 tons of rolled zinc in 1946, the rolling mills processed 50,133 tons of rolled zinc (including that which was remelted and rerolled) in manufacturing 32,429 tons of semifabricated and finished products.

Rolled zinc produced and quantity available for consumption in the United States, 1945–46

	1945			1946		
	Short tons	Value		Short tons	Value	
		Total	Average per pound		Total	Average per pound
Production:						
Sheet zinc not over 0.1 inch thick	16,746	$4,624,274	$0.138	27,088	$8,581,082	$0.158
Boiler plate and sheets over 0.1 inch thick	3,057	717,301	.117	1,615	389,904	.121
Strip and ribbon zinc [1]	77,175	18,817,191	.122	62,350	16,460,388	.132
Foil, rod, and wire	1,406	559,213	.199	1,595	624,508	.196
Total rolled zinc	98,384	24,717,979	.126	92,648	26,055,882	.141
Imports	[2]			[2]		
Exports	5,418	1,484,826	.137	11,957	3,693,009	.154
Available for consumption	[3] [4] 92,781			[3] 80,633		
Value of slab zinc (all grades)			.086			.089
Value added by rolling			.040			.052

[1] Figures represent net production. In addition, 31,968 tons of strip and ribbon zinc in 1945 and 18,670 tons in 1946 were rerolled from scrap originating in fabricating plants in connection with zinc rolling mills.
[2] Less than 1 ton.
[3] Allowances made for change in producers' stocks of rolled zinc.
[4] Revised figure.

The following table shows the six commercial grades of refined slab zinc and purchased remelt spelter consumed by the various industries in 1946. Of the 801,242 tons of domestic and foreign zinc consumed, 37 percent was Prime Western, 32 percent Special High Grade, and 17 percent Regular High Grade, compared with 38, 25, and 22 percent, respectively, in 1945. All grades of zinc were used for galvanizing and in the manufacture of brass and rolled zinc products. Prime Western was the principal grade used in the hot-dip process of galvanizing, the higher grades being used chiefly for electrogalvanizing. Rigid specifications in brass manufacture necessitate the use of high-purity metal, 66 percent of the total used in this industry being of the two highest grades.

Consumption of slab zinc in the United States in 1946, by grades, according to industry, in short tons

	Special High Grade	Regular High Grade	Intermediate	Brass Special	Selected	Prime Western	Remelt	Total
Galvanizing	11,514	14,610	10,985	12,870	973	266,270	2,537	319,759
Brass products	33,975	64,239	11,193	14,046	261	24,613	775	149,102
Zinc-base alloy	207,063	3,905	688			229	326	212,211
Rolled zinc	3,854	35,778	11,545	36,498	1,160	3,562		92,397
Zinc oxide	1,870	17,300						19,170
Other uses	1,381	3,469	1,281	669		1,529	274	8,603
Total	259,657	139,301	35,692	64,083	2,394	296,203	3,912	801,242

STOCKS

Producers' Stocks.—Inventories of slab zinc at producers' plants dropped 31 percent in 1946 and were the lowest recorded since 1943. Of the 176,342 tons on hand at the end of the year, 123,231 tons were Special High Grade and Regular High Grade and the remainder (53,111 tons) of lower grades, compared with 169,679 tons and 86,537 tons, respectively, at the end of 1945. Nearly the entire decline can be accounted for by reduced inventories of Prime Western (75 percent) and Special High Grade and Regular High Grade (27 percent).

Stocks of zinc ore (60 percent concentrates) in the Tri-State district (as reported by the Tri-State Zinc and Lead Ore Producers' Association) were 3,677 tons, lowest for the year, at the beginning of 1946. Inventories increased to 6,930 tons on March 23 but declined thereafter to 3,988 tons on July 13. High point of the year was reached on November 2, with a total of 10,614 tons, followed by a general downward trend to 8,328 tons on December 28.

Stocks of zinc on hand at zinc-reduction plants in the United States at end of year, 1942–46, in short tons

	1942	1943	1944	1945	1946
At primary reduction plants	82,498	168,777	233,044	254,765	175,586
At secondary distilling plants	1,942	1,829	652	1,451	756
	84,440	170,606	233,696	256,216	176,342

Consumers' Stocks.—Stocks of slab zinc at consumers' plants increased markedly in 1946, the total on December 31 being 28 percent over the quantity on hand at the beginning of the year. Inventories increased abruptly at the first of the year to a high of about 116,300 tons on May 31, followed by a general downward trend during the remainder of the year. At the average monthly rate of consumption in 1946, consumers' stocks on hand at the end of 1946 were slightly more than 1 month's requirements.

Consumers' stocks of slab zinc at plants at the beginning and end of 1946, by industries, in short tons

	Galvanizers	Die casters [1]	Brass mills [2]	Zinc rolling mills	Oxide plants	Others	Total
Dec. 31, 1945	[3] 33,086	[3] 12,791	[3] 18,185	6,317	[3] 585	[3] 1,417	[3] [4] 72,381
Dec. 31, 1946	42,678	22,271	20,041	6,548	346	1,104	[4] 92,988

[1] Includes producers of zinc-base die castings, zinc-alloy dies, and zinc-alloy rods.
[2] Includes brass mills, brass ingot makers, and brass products.
[3] Revised figure.
[4] Stocks on December 31, 1945 and 1946, exclude 416 tons and 497 tons, respectively, of remelt spelter.

PRICES

The base ceiling price established by the Office of Price Administration of 8.25 cents a pound for Prime Western grade slab zinc at St. Louis remained unchanged through June 30. A bill to extend the OPA was vetoed by the President on June 29, and on July 3 the price of zinc advanced to 9.50 cents, St. Louis. With reestablishment of the OPA by legislative action on July 25, the former ceiling price of 8.25 cents became effective and prevailed until October 14, when the OPA announced an upward revision of 1 cent per pound in the ceiling price, establishing the market at 9.25 cents, St. Louis. The OPA order of November 12, retroactive to November 10, removed ceiling prices from all metals and opened the way for a further price advance on November 12 to 10.50 cents, St. Louis, the highest quotation on Prime Western zinc since March 1917. The weighted average price received by the producers for all grades of zinc sold in 1946 was 8.9 cents a pound, f. o. b. plants, compared with 8.6 cents in 1945. The 1946 price of 12.2 cents for zinc, which appears in the State chapters of this volume, represents the weighted average price received for all grades of slab zinc (8.9 cents) plus the increment—in terms of cents per pound based upon the total mine output of recoverable zinc—of $37,954,842 in subsidies for overquota production and special mine and smelter contracts paid by the Office of Metals Reserve.

The general policy of the Quota Committee pertaining to the Premium Price Plan for overquota mine production of domestic zinc (copper and lead were also included) prevailed through June but collapsed with expiration of the OPA and ceiling prices on June 30. Upon reestablishment of the OPA in late July provisions were made for retroactive premium payments to cover the period when no plan was in effect. The Premium Price Plan was extended until June 30, 1947, under the same terms as in the past, except that incorporated in the subsidy section of the bill extending the OPA was a provision that "adjustments shall be made to encourage exploration and development work and adequate allowances for depreciation and depletion." The bill further provided that all classes of premiums were noncancelable unless necessary to make individual adjustments of income to specific mines. With the abandonment of metal price ceilings on November 10, subsidies to mines financially aided by the Premium Price Plan were computed with average monthly market quotations as a base. A compilation of important data showing production of zinc under the Premium Price Plan, 1943–46, at the various quota levels and the payments made, is given in the following table.

793065—48——80

Salient statistics on zinc with regard to operation of Premium Price Plan, 1943–46 [1]

	1943			1944			1945			1946		
	Tri-State district	U. S. exclusive of Tri-State	U. S. total	Tri-State district	U. S. exclusive of Tri-State	U. S. total	Tri-State district	U. S. exclusive of Tri-State	U. S. total	Tri-State district	U. S. exclusive of Tri-State	U. S. total
Total production of recoverable zinc [2] short tons	200,103	540,565	740,668	200,341	515,465	715,806	140,181	474,177	614,358	137,858	427,929	565,787
Ceiling production at 8.25 cents a pound...do	11,930	326,251	338,181	20,911	251,105	272,016	5,672	204,633	210,305	2,253	165,896	168,149
Ceiling production, proportion of total...percent	5.96	60.35	45.66	10.44	48.71	38.00	4.05	43.16	34.23	1.63	38.77	29.72
Overceiling production under Premium Price Plan:												
"A" quota only (11.00 cents a pound) short tons	92,650	146,639	239,289	65,714	171,328	237,042	41,388	191,328	232,716	[3] 15,594	[3] 132,861	[3] 148,455
"B" quota (13.75 cents a pound)...do	58,243	40,045	98,288	65,779	56,015	121,794	52,135	39,444	91,579	[3] 35,082	[3] 36,152	[3] 71,234
"C" quota (16.50 cents a pound)...do	34,803	22,778	57,581	42,080	31,421	73,501	35,192	36,009	71,201	[3] 56,956 [4] 22,262	[3] 44,861 [4] 47,136	[3] 101,817 [4] 69,398
Total premium production...do	185,696	209,462	395,158	173,573	258,764	432,337	128,715	266,781	395,496	129,894	261,010	390,904
Metals Reserve mine contracts...do	2,477	4,852	7,329	5,857	5,596	11,453	5,794	2,763	8,557	5,711	1,023	6,734
Total overceiling production...do	188,173	214,314	402,487	179,430	264,360	443,790	134,509	269,544	404,053	135,605	262,033	397,638
Overceiling production, proportion of total: Production under Premium Price Plan:												
"A" quota only...percent	46.30	27.13	32.31	32.80	33.24	33.12	29.53	40.35	37.88	[3] 11.31	[3] 31.05	[3] 26.24
"B" quota (also received "A")...do	29.11	7.41	13.27	32.83	10.87	17.01	37.19	8.32	14.91	[3] 25.45	[3] 8.45	[3] 12.59
"C" quota (also received "A" and "B") percent	17.39	4.21	7.77	21.01	6.09	10.27	25.10	7.59	11.59	[3] 41.31 [4] 16.15	[3] 10.48 [4] 11.01	[3] 17.99 [4] 12.27
Total premium production...do	92.80	38.75	53.35	86.64	50.20	60.40	91.82	56.26	64.38	94.22	60.99	69.09
Metals Reserve mine contracts...do	1.24	.90	.99	2.92	1.09	1.60	4.13	.58	1.39	4.15	.24	1.19
Total overceiling production...do	94.04	39.65	54.34	89.56	51.29	62.00	95.95	56.84	65.77	98.37	61.23	70.28
Payments under Premium Price Plan: [5]												
"A" premium...dollars	10,213,269	11,520,444	21,733,713	9,546,487	14,283,080	23,829,567	7,079,337	14,672,969	21,752,306	[3] 5,802,964	[3] 11,490,232	[3] 17,293,196
"B" premium...do	5,117,544	3,455,281	8,572,825	5,932,208	4,809,086	10,741,294	4,802,986	4,149,882	8,952,868	[3] 5,081,379	[3] 4,296,471	[3] 9,377,850
"C" premium...do	1,914,183	1,252,814	3,166,997	2,314,401	1,728,271	4,042,672	1,935,543	1,980,489	3,916,032	[3] 3,153,057 [4] 2,411,597	[3] 2,383,854 [4] 2,576,074	[3] 5,536,911 [4] 4,987,671
Total premium production...do	17,244,996	16,228,539	33,473,535	17,793,096	20,820,437	38,613,533	13,817,866	20,803,340	34,621,206	16,448,997	20,746,631	37,195,628
Metals Reserve payments to smelters [5]...do				402,580		402,580	875,247		875,247			

Metals Reserve mine contracts [5]—dollars	225,005	280,353	505,358	578,737	313,792	892,529	550,979	157,745	708,724	698,862	60,352	759,214
Total overceiling payments—do	17,470,001	16,508,892	33,978,893	18,774,413	21,134,229	39,908,642	15,244,092	20,961,085	36,205,177	17,147,859	20,806,983	37,954,842
Average prices per pound of zinc: [6]												
Average premium production—cents	12.893	12.124	12.485	13.376	12.273	12.716	13.618	12.150	12.627	15.218	12.861	13.645
Metals Reserve mine contracts—do	12.791	11.139	11.698	13.190	11.054	12.146	13.005	11.105	12.391	15.005	11.837	14.524
Total overceiling production—do	12.892	12.102	12.471	13.482	12.247	12.746	13.917	12.138	12.730	15.210	12.857	13.660
Total production—do	12.615	9.777	10.544	12.936	10.300	11.038	13.687	10.460	11.197	15.106	11.318	12.241

[1] From published and unpublished reports of the Office of Price Administration and the Office of Premium Price Plan for Copper, Lead, Zinc, and Manganese.

[2] Production of Tri-State zinc from Office of Metals Reserve agency, Joplin, Mo.; all other from Bureau of Mines monthly reports. These data are preliminary and do not exactly equal final annual totals for the United States except for 1945.

[3] January-October. "A", "B", and "C" quotas and premium payments for November and December are not separable and are shown with footnote 4.

[4] Total "A", "B", and "C" quotas and premium payments for November and December; separation by kinds not available.

[5] Data on premium payments, payments to smelters, and Metals Reserve mine-contract payments from Office of Metals Reserve. All payments shown are subject to correction due to additional payments as a result of retroactive quota adjustments, late reports by smelters and custom mills, etc.

[6] All average prices shown include OPA ceiling price.

The official London maximum price of £31 5s. per long ton, duty paid, for foreign zinc delivered to consumers, fixed by the British Ministry of Supply on June 11, 1945, was advanced to £39 5s. on April 8, 1946. Subsequent price advances during the year occurred on July 1 and November 13 when quotations rose to £50 and £55, respectively. The London price remained unchanged the balance of the year but was raised to £70 per long ton beginning January 1, 1947. Quotations of the London Metal Exchange, discontinued at the outbreak of the war in September 1939, were not resumed during 1946.

Price of zinc and zinc concentrates, 1942–46

	1942	1943	1944	1945	1946
Average price common zinc at—					
St. Louis (spot) ---- cents per pound	8.25	8.25	8.25	8.25	8.73
New York ---- do	8.66	8.66	8.65	8.65	9.15
London [1] ---- do	4.63	4.63	4.63	5.18	7.75
Excess New York over London ---- do	4.03	4.03	4.02	3.47	1.40
Joplin 60-percent zinc concentrates:					
Price per short ton ---- dollars	55.28	55.28	55.28	55.28	51.12
Price indexes (1925–29 average=100):					
Zinc (New York)	122	122	122	122	128
Lead (New York)	87	87	87	87	109
Copper (New York)	80	80	80	80	93
Nonferrous metals [2]	87	87	87	87	100
All commodities [2]	101	105	106	108	121

[1] Average price for foreign zinc, converted to cents per pound with the pound sterling at $4.02½.
[2] Based upon price indexes of U. S. Department of Labor.

Average monthly quoted prices of common zinc (prompt delivery or spot) St. Louis and London, and of 60-percent zinc concentrates at Joplin, 1945–46 [1]

Month	1945			1946		
	60-percent zinc concentrates in the Joplin region (dollars per ton) [2]	Metallic zinc (cents per pound)		60-percent zinc concentrates in the Joplin region (dollars per ton) [2]	Metallic zinc (cents per pound)	
		St. Louis	London [3]		St. Louis	London [3]
January	$55.28	8.25	4.63	50.00	8.25	5.62
February	55.28	8.25	4.63	50.00	8.25	5.62
March	55.28	8.25	4.63	50.00	8.25	5.62
April	55.28	8.25	4.63	50.00	8.25	6.72
May	55.28	8.25	4.63	50.00	8.25	7.05
June	55.28	8.25	5.34	50.00	8.25	7.05
July	55.28	8.25	5.62	[4]	9.24	8.98
August	55.28	8.25	5.62	50.00	8.25	8.98
September	55.28	8.25	5.62	50.00	8.25	8.98
October	55.28	8.25	5.62	50.00	8.87	8.98
November	55.28	8.25	5.62	60.00	10.12	9.52
December	55.28	8.25	5.62	64.00	10.50	9.88
Average for year	55.28	8.25	5.18	51.12	8.73	7.75

[1] Joplin: Metal Statistics, 1947, p. 562. St. Louis: Metal Statistics, 1947, p. 559. London: E&MJ Metal and Mineral Markets.
[2] Does not include Government premium of $29.70 a ton on zinc concentrates payable for overquota production.
[3] Average price for foreign zinc converted to cents per pound with the pound sterling at $4.02½. Official maximum price raised on June 11, 1945, and Apr. 8, July 1, and Nov. 13, 1946.
[4] No market due to uncertainty of Premium Price Plan subsidies.

Average price received by producers for zinc, 1942–46, by grades, in cents per pound [1]

	1942	1943	1944	1945	1946
Grade A: [2]					
Special High Grade	9.00	8.91	8.90	8.89	9.18
Regular High Grade	9.10	8.74	8.62	8.60	8.81
Grade B: Intermediate	8.64	8.71	8.74	8.66	9.08
Grades C and D: [2]					
Brass Special	8.32	8.46	8.48	8.48	9.00
Selected	8.18	7.95	8.27	8.32	8.89
Grade E: Prime Western	8.23	8.31	8.24	8.24	8.60
All grades	8.7	8.6	8.6	8.6	8.88
Prime Western; spot quotation at St. Louis	8.25	8.25	8.25	8.25	8.73

[1] Does not include overquota premium payments made by Office of Metals Reserve.
[2] American Metal Market quotes average prices (delivered) of High Grade and Brass Special as follows: High Grade (f. o. b. New York)—1942–45, 9.25 cents; 1946, 9.73 cents. Brass Special (f. o. b. East St. Louis)—1942–45, 8.50 cents; 1946, 8.98 cents.

FOREIGN TRADE [4]

Imports.—Total imports of zinc in ores and concentrates in 1946 declined 29 percent from 1945. Of the 272,056 tons of zinc imported in ores and concentrates in 1946, approximately 47 percent came from Mexico, 21 percent from Canada, 18 percent from Peru, 10 percent from Bolivia, 3 percent from Argentina, and 1 percent from Australia. Slab zinc imports increased 8 percent over 1945 and were the greatest of any year in the history of the zinc industry. A 56-percent decrease in imports from Mexico were more than offset by an 83-percent gain in the quantity of slab zinc imported from Canada.

Zinc imported into the United States in ore, blocks, pigs, or slabs, 1944–46, by countries, in short tons [1]

Country	1944	1945	1946
Ore (zinc content):			
Argentina	22,253		8,295
Australia	42,216	15,377	3,780
Bolivia	5,305	5,771	26,207
Canada	112,297	90,200	57,298
Chile [2]	96	34,438	
Mexico	177,625	177,003	127,685
Newfoundland and Labrador	19,013	23,515	
Peru	43,889	35,415	48,791
Other countries			[3]
	422,694	381,719	272,056
Blocks, pigs, or slabs:			
Australia	4,480	14,417	3,221
Canada	18,099	46,594	85,194
Mexico	39,703	36,105	15,777
Other countries	1,344		551
	63,626	97,116	104,743

[1] Data include zinc imported for immediate consumption plus material entering country under bond.
[2] Substantially all zinc shown as received from Chile originated in Bolivia and was shipped from Chilean ports.
[3] Less than 1 ton.

[4] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

Zinc imported for consumption in the United States, 1942–46, by classes

Year	Ores (zinc content)		Blocks, pigs, slabs		Sheets		Old, dross and skimmings [1]		Zinc dust		Total value [2]
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	
1942	283,167	$10,723,983	36,352	$2,924,438	50	$10,086	3,357	$158,929	702	$43,464	$13,860,900
1943	516,646	20,475,688	56,155	5,825,874	(3)	56	5,146	226,754	106	17,585	26,545,957
1944	415,004	18,678,957	63,626	6,132,877	15	2,540	5,603	300,188	------	------	25,114,562
1945	330,397	14,962,057	96,710	12,165,873	(3)	2	7,331	477,893	362	39,789	27,645,614
1946	166,885	8,122,471	104,015	16,474,850	(3)	10	4,137	300,429	77	4,942	24,902,702

[1] Includes dross and skimmings as follows—1942: 3,214 tons, $150,913; 1943: 5,032 tons, $216,425; 1944: 4,694 tons, $224,995; 1945: 4,323 tons, $231,946; and 1946: 2,851 tons, $188,972.
[2] In addition, manufactures of zinc imported as follows—1942: $16; 1943: $35,355; 1944: $14,223; 1945: $8,077; and 1946: $1,929.
[3] Less than 1 ton.

Exports.—The value of export of zinc ores (and concentrates) and manufactured articles containing zinc of foreign and domestic origin (excluding galvanized products, alloys, and pigments) amounted to $11,199,007 in 1946, compared with $2,956,222 in 1945. In addition to the items shown in the accompanying tables, considerable zinc is exported each year in brass, pigments, chemicals, and galvanized iron and steel. Export data on zinc pigments and chemicals are given in the Lead and Zinc Pigments and Zinc Salts chapter of this volume. Much of the zinc used in the manufacture of such products is of foreign origin, and when they are exported a draw-back of 99 percent of the import duty is refunded upon the basis of zinc contained in the finished product. Data covering draw-back in 1945 and 1946 are not yet available. Draw-back refunds were made on 7,274 tons in 1943 and on 29,738 tons in 1944.

Zinc ore and manufactures of zinc, exported from the United States, 1942–46

Year	Zinc ore, concentrates, and dross (zinc content)		Slabs, plates, or blocks		Sheets, strips, or other forms, n. e. s.		Zinc dust	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1942	(1)	$18	133,938	$22,828,929	4,767	$1,289,889	1,772	$417,957
1943	1	305	97,439	17,167,729	3,167	891,132	5,859	1,263,296
1944	(1)	38	21,576	3,717,643	4,020	1,065,206	295	74,478
1945	(1)	67	7,782	1,126,910	6,235	1,747,937	330	81,308
1946	89	15,440	37,431	6,625,800	13,846	4,468,328	366	89,439

[1] Less than 1 ton.

Slab and sheet zinc exported from the United States, 1943–46, by destinations, in short tons

Destination	Slabs, plates, and block				Sheets, strips, or other forms, n. e. s.			
	1943	1944	1945	1946	1943	1944	1945	1946
Country:								
Argentina			110	3,705	91	146	274	1,353
Australia	(1)				48		5	(1)
Belgium and Luxembourg			2,060	4,153			(1)	5
Brazil	1,528	1,069	441	1,301	79	145	321	1,256
Canada	13,347	4,132	24	1	2,160	2,704	2,956	2,975
Chile	107	17	587	643	24	18	7	322
China	2,170			417	5	5	2	757
Cuba	(1)	1	141	67	56	42	67	70
Czechoslovakia				1,118				
Finland				950				9
France			2,204	(1)				7
India	5,818			4,080	1	4	10	324
Mexico	161	473	113	54	196	278	413	460
Netherlands				2,491				72
Portugal			17	2			277	520
Sweden			470	1,181			94	537
Switzerland			1,336	4,205			110	956
Turkey			3	179			243	2,388
Union of South Africa	1,329				144	60	186	38
U. S. S. R.	23,477	1,151					1	10
United Kingdom	48,540	14,669		12,760	2	8	4	46
Other countries	962	64	276	124	361	610	1,265	1,741
	97,439	21,576	7,782	37,431	3,167	4,020	6,235	13,846
Continent:								
North America	13,509	4,621	300	136	2,389	3,095	3,509	3,603
South America	1,652	1,112	1,391	5,753	317	438	1,018	3,254
Europe	72,017	15,820	6,087	26,863	74	97	643	2,345
Asia	7,991	22	3	4,679	13	10	364	3,919
Africa	2,269	1	1	(1)	322	379	693	724
Oceania	1	(1)			52	1	8	1

[1] Less than 1 ton.

WORLD REVIEW

World production of zinc in recent years, insofar as data are available is shown in the accompanying table.

World smelter production of zinc, 1940–46, by countries where smelted, in metric tons

[Compiled by B. B. Mitchell]

Country	1940	1941	1942	1943	1944	1945	1946
Argentina			410	728	1,200	1,542	1,814
Australia	77,176	78,945	75,474	76,972	79,979	85,118	78,540
Belgium	70,410	38,690	28,620	27,770	8,660	11,712	86,224
Canada	168,486	193,784	195,769	187,342	152,876	166,302	168,431
China	250	214	396	500	331	328	
Czechoslovakia	(1)	(1)	(1)	(1)	(1)	(2)	(2)
France	37,843	25,918	22,829	21,490	8,793	8,184	30,361
Germany [3]	317,600	317,600	314,100	312,000	259,600	(2)	28,429
Indochina, French	6,104	6,251	5,462	4,138	[4] 622		
Italy	39,338	38,800	33,545	[5] 15,460		1,565	15,605
Japan [4]	59,214	62,177	54,730	60,948	62,673	18,553	(2)
Mexico	33,388	38,678	51,743	54,449	49,248	48,985	41,982
Netherlands	5,049	3,718	5,153	4,565	2,105		2,011
Northern Rhodesia	13,402	13,762	13,046	13,620	14,712	15,485	17,466
Norway	17,229	6,464	7,693	15,376	11,777	9,228	31,030
Peru	178	752	941	1,225	1,447	1,688	1,473
Poland	(1)	(1)	(1)	(1)	(1)	36,385	56,614
Spain	12,322	19,143	19,150	19,200	18,054	17,310	17,568
Sweden					1,790	2,929	
U. S. S. R.	[4] 85,000	(2)	(2)	(2)	(2)	(2)	(2)
United Kingdom [7]	60,025	68,677	72,437	70,345	73,190	63,034	66,405
United States	612,596	745,720	809,088	854,844	788,613	693,594	660,665
Yugoslavia	4,989	(2)	(2)	(2)	(2)	(2)	(2)
Total	1,620,600	1,749,200	1,800,000	1,830,500	1,625,200	1,273,800	1,406,500

[1] Included with Germany.
[2] Data not available; estimate by senior author of chapter included in total.
[3] Includes Austria, Czechoslovakia, and Poland in 1940–44.
[4] Estimated.
[5] January to June, inclusive.
[6] Preliminary data for fiscal year ended March 31 of year following that stated.
[7] Some secondary metal included.

Argentina.—The Aguilar mine of the Compania Minera Aguilar, S. A., subsidiary of the St. Joseph Lead Co., continued to be the leading producer in 1946, although the property operated at about 60 percent capacity owing to shortage of mine timber, fuel oil, and inability of the railroad to provide enough cars for shipping concentrates from the mine. The zinc-concentrates production at the Aguilar mine in 1946 was 29,601 metric tons compared with 25,862 tons in 1945.

Australia.—Labor shortages and the difficulty in obtaining new mining machinery continued to restrict zinc production at Australian mines and smelters in 1946.

The production of crude ore at the Broken Hill South, Ltd., for the fiscal year ended June 30, 1946, was 293,130 long tons compared with 309,605 tons for the previous year.

The Lake George Mining Corp., Ltd., at Captain's Flat, New South Wales, produced 135,244 tons of ore for the fiscal year ended June 30, 1946, compared with 164,549 tons for the previous year. The total estimated ore reserves remaining at the property on June 30 were 1,382,753 tons assaying 1.1 dwt. gold and 1.4 ounces of silver per ton, and 7.2 percent lead, 12.4 percent zinc, and 0.7 percent copper.

The electrolytic plant of the Electrolytic Zinc Co. of Australasia, Ltd., at Risdon, Tasmania, which treats zinc concentrates from Broken Hill, New South Wales, as well as from the company-owned Tasmanian mines, produced 77,299 long tons of slab zinc during 1946.

Canada.—At Trail, British Columbia, the Consolidated Mining & Smelting Co. continued to be the principal source of Canadian zinc production. According to the company's annual report to stockholders, slab zinc produced at the electrolytic plant at Trail was 134,393 short tons compared with 134,873 tons in 1945. Ore reserves at the end of the year showed a net increase of about 3.3 million tons.

The Hudson Bay Mining & Smelting Co., Ltd., at Flin Flon, Manitoba, according to the company's annual report to stockholders, produced 1,837,472 short tons of ore in 1946. About 145,900 tons of zinc concentrates averaging 45.4 percent zinc were produced at the company flotation mill. Slab-zinc production at the company electrolytic plant was 51,328 tons compared with 47,468 tons in 1945. At Sherridon, Manitoba, the Sherritt Gordon Mines, Ltd., milled 558,836 tons of ore in 1946, from which 17,291 tons of zinc concentrates were recovered. Ore reserves in the West mine at the end of 1946 were 1,368,000 tons averaging 2.12 percent zinc and 2.60 percent copper; known ore at the East mine was completely mined out during the year.

The Normetal Mining Corp., Ltd., at Normetal, Quebec, during the year milled 186,634 tons of ore averaging 3.64 percent copper and 7.04 percent zinc, which yielded 20,508 short tons of zinc concentrate (52.88 percent zinc), in addition to copper concentrate. Ore reserves at year end were 1,716,000 tons averaging 7.28 percent zinc and 3.68 percent copper. Ore reserves at the Waite Amulet Mines, Ltd., were reduced from 2,517,538 tons in 1945 to 1,997,739 tons at the end of 1946.

Mexico.—Labor strikes, poor railroad facilities, and high taxes were the principal factors limiting Mexican zinc output in 1946. On December 31, 1945, a general strike of Mexican mine and smelter

labor, originally scheduled for December 17, shut off zinc output until the end of February 1946, when new wage scales were established and the workers returned to their jobs.

Newfoundland.—The mine production of zinc, in terms of zinc content of concentrates produced, totaled 87,673 short tons in 1946 compared with 49,350 tons in 1945.

United Kingdom.—Consumption of zinc in the United Kingdom totaled 289,364 long tons in 1946, of which 216,089 tons were primary zinc and 73,275 tons secondary (including remelted) zinc. Comparable figures for 1945 were 250,383 tons consumed, of which 173,323 tons were primary and 77,060 tons secondary. Of the total zinc consumed in 1946, 33 percent was used in brass products, 25 percent in galvanizing, 19 percent in zinc oxide, 9 percent in rolled zinc, 7 percent for die castings, and 7 percent for zinc dust and miscellaneous uses.

U. S. S. R.—Virtually no official production figures have been available on the Russian zinc industry during the last 7 years. Data, however, presented in the announcement March 1946 of the new Five Year Plan indicate that zinc output has been declining in recent years.

Minor Metals

By ALLAN F. MATTHEWS[1]

	PAGE		PAGE
Barium	1266	Germanium	1275
Beryllium	1266	Indium	1276
Boron	1269	Lithium	1277
Calcium	1270	Radium and mesothorium	1277
Cerium and other rare-earth metals	1271	Rhenium	1279
Columbium and tantalum	1272	Selenium and tellurium	1280
Gallium	1275	Thallium	1281
		Zirconium	1282

BARIUM

SEVERAL thousand pounds of barium metal are produced annually in the United States. The output in 1946 was only about half that in 1945, reflecting the decline in demand for military electronic equipment. The two domestic producers were Kemet Laboratories Co., Inc. (unit of Union Carbide & Carbon Corp.), Cleveland, Ohio, and King Laboratories, Inc., Syracuse, N. Y. Barium metal production is contemplated by Dominion Magnesium, Ltd., Haley's Station, near Ottawa, Ontario. The metal sold for a few dollars a pound during 1946.

The principal use of barium metal is as a getter—a material that is installed or vaporized inside an electronic tube to absorb residual gases and thus promote the vacuum on which the efficiency of the tube depends. In this application the barium was often alloyed with other alkaline-earth metals and with light metals, but the present tendency is away from magnesium toward compositions more nearly pure barium. Lead-base bearing alloys used in Germany during World War II were hardened by 0.4 percent Ba.

Barium ores and chemicals are discussed in the Barite chapter of this volume.

BERYLLIUM

Demand for beryllium subsided somewhat in 1946 compared with that during the war, but the problem of obtaining enough beryl from foreign or domestic sources to sustain the refining industry in the United States remained acute. Beryllium metal became subject to export control November 27, 1946.

Domestic Mine Production.—Beryl was shipped from mines in 1946 by the Whitehall Co., Inc., Grafton and Raymond, N. H., and by the following companies and individuals in South Dakota: Consoli-

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

dated Feldspar Corp. and John D. Fisher, both near Custer; and Vincent and J. B. Cordes, Keystone Feldspar & Chemical Co., Harry A. Linde, and Lor Mining Co.—all four near Keystone. Spectrographic Services & Supplies, Inc., Saratoga Springs, N. Y., assigned a geologist to explore further the helvite deposit at Iron Mountain, north of Winston, N. Mex.

Beryllium concentrates (beryl) shipped from mines in the United States, 1940–46, by States, in short tons

[Compiled by R. W. Metcalf]

State	1940	1941	1942	1943	1944	1945	1946
Colorado	(1)		3	68	35		
Maine	(1)	(1)	45	2	2		
Massachusetts				(1)	4		
New Hampshire		(1)	16	42	(1)	1	5
New Mexico				(1)	29		
South Dakota	74	151	205	238	306	38	95
Other [2]	47	7		6	12		
Total: Short tons	121	158	269	356	388	39	100
Value	$3,721	$7,300	$24,188	$44,407	$56,135	$6,133	$17,787
Average per ton	$30.75	$46.20	$89.92	$124.74	$144.68	$157.26	$177.87

[1] Included with "Other." Bureau of Mines not at liberty to show separately.
[2] Figures include—1940: Colorado, Maine; 1941: Maine, New Hampshire, Wyoming; 1943: Massachusetts, New Mexico, North Carolina, Virginia; 1944: Connecticut, New Hampshire, North Carolina, Virginia.

Domestic Refiners and Fabricators.—The three beryllium refineries in the United States in 1946 were operated by the Beryllium Corp., Temple, near Reading, Pa. (beryllium-copper and beryllium oxide); Brush Beryllium Co., Cleveland, Ohio (metal, alloys, and compounds); and Clifton Products, Inc., Painesville, Ohio (oxide). As a result of Government-financed expansion during the war, a part of each refinery was owned by the War Assets Administration; the Beryllium Corp. in 1946 purchased the Government's share at Temple for $788,210. Government facilities at Cleveland cost $922,460 to build, and those at Painesville cost $286,087. The principal companies that consumed beryllium-copper master alloy in making beryllium-copper sheet, wire, rod, and bar were the American Brass Co., Waterbury, Conn.; the Beryllium Corp.; Wilbur B. Driver Co., Newark, N. J.; and Riverside Metal Co., Riverside, N. J. The American Brass Co. discontinued its beryllium-copper business at about the end of 1946 because it considered such a specialty item out of place in a large mill. An agreement between the United Steelworkers of America (CIO) and the Beryllium Corp. in mid 1946 provided for guaranteed annual wages.

Consumption and Uses.—Consumption of beryl for production of beryllium metal, alloys, and compounds in the United States was 1,013 short tons in 1946 compared with 1,738 tons in 1945. Addition of 2 percent beryllium hardens and strengthens copper alloys. Beryllium oxide is used in fluorescent lamps as a phosphor (material capable of absorbing ultraviolet light and emitting it as visible light) and in special refractories.[2] The metal is fabricated into windows for X-ray tubes and used in atomic energy apparatus.

[2] Geller, R. F., Yavorsky, P. J., Steierman, B. L., and Creamer, A. S., Studies of Binary and Ternary Combinations of Magnesia, Calcia, Baria, Beryllia, Alumina, Thoria, and Zirconia in Relation to Their Use as Porcelains: Jour. Nat. Bureau of Standards, vol. 36, No. 3, March 1946, pp. 277–312.

Stocks.—The principal consumers of beryl increased their stocks from 90 short tons at the beginning of 1946 to 879 tons at the end of the year. As a result of shipments to industry during 1946, beryl stocks of the Office of Metals Reserve declined from 4,497 tons to 4,118 tons.

Prices.—Domestic beryl, 8 to 12 percent BeO, was nominally quoted at $8–$10 per short-ton unit of BeO, f. o. b. mines, during 1946, according to E&MJ Metal and Mineral Markets. A higher price would doubtless have been paid, particularly later in the year, for any sizable lot offered. Foreign beryl, delivered consumer's plant, was listed by the American Metal Market at $10–$11 per unit for 8–10 percent BeO early in 1946, $10.39–$12.39 for 10–12 percent BeO from mid March to mid November, $13.50–$15.50 in late November and early December, and $14–$16, f. o. b. Atlantic port, during the remainder of the month. The price of beryllium copper master alloy, 4 percent Be, was reduced in February 1946 from $15 to $14.75 per pound of contained beryllium. In that month the Office of Price Administration relinquished control of the price of beryllium.

Foreign Trade.—Imports of beryl in 1946 declined for the third successive year, although they were greater than in any year prior to 1941. Exports of beryllium ore in 1946 were 2,751 pounds valued at $2,894. Beryllium metal, alloys, and scrap exported during the year totaled 139,735 pounds valued at $130,291; of that quantity, 76,516 pounds went to the United Kingdom, 30,613 to Canada, 20,000 to Switzerland, and 12,606 to nine other countries.

Beryllium ore (beryl concentrates) imported for consumption in the United States, 1942–46, by countries, in short tons

Country	1942	1943	1944	1945	1946
Anglo-Egyptian Sudan			1		
Argentina	703	1,162	229		53
Australia		457	518	105	20
Brazil	912	2,551	1,453	572	906
British East Africa			15	7	
India	397	509	892	484	119
Madagascar		74		11	
Nigeria				22	
Portugal		1			
Southern Rhodesia			7		
Union of South Africa	38	86	(1)		
Total: Short tons	2,050	4,840	3,115	1,201	1,098
Value	$137,597	$377,726	$286,091	$131,841	$105,708

[1] Less than 1 ton.

Technology.—Methods of refining beryllium [3] and preparing beryllium powder [4] were described.

World Review.—Production of beryllium in Germany is prohibited, in accordance with a statement issued by Allied occupation authorities in February 1946. Additional descriptions of German production

[3] Kawecki, Henry C., The Production of Beryllium Compounds, Metal and Alloys: Trans. Electrochem. Soc., vol. 89, 1946, pp. 229–236, 258–259.
Kjellgren, Bengt R. F., The Production of Beryllium Oxide and Beryllium Copper: Trans. Electrochem. Soc., vol. 89, 1946, pp. 247–261.

[4] Tien, Jack M., Preparation of Beryllium Powder: Trans. Electrochem. Soc., vol. 89, 1946, pp. 237–245.

processes and uses for beryllium were published.[5] The Italian beryllium refinery has been converted to a cast-iron foundry. The only active beryllium refinery outside of the United States in 1946 was in France, which was receiving beryl from a 500-ton stock pile in Germany. The mother country also reserved for itself the output of Madagascar. Another country that discontinued beryl shipments to the United States was India, which placed an embargo on the mineral in June 1946. Korea produced 59.6 metric tons of beryl averaging 12 percent BeO in 1944; about two-thirds of the output was from southern Korea, chiefly from one mine.[6]

World production of beryllium concentrates (beryl), 1940–46, by countries, in metric tons [1]

[Compiled by B. B. Mitchell]

Country	1940	1941	1942	1943	1944	1945	1946
Argentina	520	2,186	925	881	342	[2] 40	[3]
Australia	2	3		534	417	47	19
Brazil (exports)	1,472	1,703	1,634	2,027	1,185	510	1,294
India	53	[4]	121	1,486	508	108	[5] 100
Madagascar	[3]	[3]	[3]	[5] 67	50	[5] 10	[3]
Portugal	[3]	35	[3]	14	[2] 60	9	[3]
Portuguese East Africa	[3]	[3]	8	6	3	2	22
Spain	4	[3]	[3]	[3]	[3]	[3]	[3]
South-West Africa	[3]	20	39	36	1	5	
Uganda	[3]	[3]	[3]		18	4	[3]
United States (mine shipments)	110	143	244	323	352	35	91
World total (estimate)[6]	2,161	4,090	2,971	5,374	2,996	770	1,526

[1] In addition to countries listed, beryllium concentrates may also be produced in Finland, France, Kenya Korea, Norway, Rumania, and U. S. S. R. Canada has produced beryl but reported no sales.
[2] Estimate.
[3] Data not available.
[4] Less than 1 ton.
[5] Estimate based on United States imports.
[6] Estimate exclusive of U. S. S. R. Production in other countries for which data are not available is believed to be negligible, except that Korea produced 60 metric tons in 1944.

BORON

Production.—Shipments of boron ferro-alloys were 74 short tons containing 11 tons of boron in 1946 compared with 109 tons containing 16 tons in 1945. The producers were Electro Metallurgical Co., Niagara Falls, N. Y.; Molybdenum Corp. of America, Washington, Pa.; and Ohio Ferro-Alloys Corp., Philo, Ohio. In addition, complex addition alloys (0.2–2 percent B) such as Silvaz, Bortam, and Grainal are produced respectively by Electro Metallurgical Co.; Titanium Alloy Manufacturing Co., Niagara Falls, N. Y.; and Vanadium Corp. of America, Bridgeville, Pa.

[5] Hess, Frederic O., Investigation of Pure Oxide Ceramic Materials Intended for High-Temperature and High-Stress Applications: Off. Military Govt. for Germany (US) FIAT Final Rept. 924, Sept. 4, 1946, 24 pp. (Pub. by U. S. Department of Commerce.)
Motock, George T., Extraction and Uses of Beryllium in Germany: Bureau of Mines Inf. Circ. 7357, 1946, 12 pp.
Perrycoste, W. B. C., Production of Beryllium—"Degussa": British Intelligence Objectives Subcommittee Final Rept. 319, Item 21, London, 1945, 13 pp.
Potvin, Roger, and Farnham, G. S., The Chloride Process for Producing Beryllium in Germany: Trans. Canadian Inst. Min. and Met., vol. 49, 1946, pp. 525–538. In Canadian Min. and Met. Bull., No. 414, October 1946.
Randall, W. F., and Foster, E. M., Manufacture and Application of Specialized Magnetic Materials Generally (Including Notes on Other Alloys Requiring Similar Manufacturing Technique): British Intelligence Objectives Subcommittee Rept. 8, Item 21, London, 1945, pp. 10, 16, and appendix (13 pp.).
Stross, W., Production of Beryllia and Beryllium at "Degussa" Plants: British Intelligence Objectives Subcommittee Rept. 945, Item 21, London, 1946, 9 pp.
[6] Supreme Commander for the Allied Powers, The Mineral Industry of Korea in 1944: Nat. Resources Rept. 35, 1946, p. 9.

Uses.—Additions of 0.001 to 0.003 percent of boron to steel increase hardenability (depth of hardness). The effects of such additions and the methods of introducing boron and of analyzing it were described in a Bureau of Mines report,[7] which includes a comprehensive bibliography. A report on boron in steel, prepared by the War Metallurgy Committee of the National Academy of Sciences [8] in late 1942, was published. From the standpoint of hardenability, boron was found to be able to replace at least half of the molybdenum in cast or wrought nickel-chromium-molybdenum or manganese-molybdenum steels originally containing 0.4 percent molybdenum.[9]

Prices.—Ferroboron, 17.5 percent B, was quoted throughout 1946 at $1.30 a pound for less-than-ton lots in the eastern area, according to Iron Age.

Ores.—Boron minerals are discussed in the Magnesium Compounds and Miscellaneous Salines chapter of this volume.

CALCIUM

Domestic Production.—Calcium metal was produced in the United States in 1946 only by the Electro Metallurgical Co., Sault Ste. Marie, Mich. There was no output during the year by the New England Lime Co., Canaan, Conn., which during World War II produced as much as 10,000 pounds of high-purity metal (98–99 percent Ca) a day and had a capacity of twice that rate. The process at the Canaan plant involved thermal reduction and high-vacuum distillation.[10] About 1,000,000 pounds of calcium hydride was manufactured from purchased metal during the war by Metal Hydrides, Inc., Beverly, Mass., a subsidiary of Ventures, Ltd.[11]

Uses.—Calcium metal is used in deoxidizing and scavenging steel melts and, to a much lesser extent, in reducing metals such as chromium, thorium, and zirconium. Calcium hydride is a conveniently portable source of hydrogen for inflating weather and signal balloons, and large quantities were utilized for that purpose by the United States Signal Corps and the Royal Air Force during World War II. Lead alloys containing 0.03 to 0.7 percent calcium are made into cable sheaths, storage-battery grids, and bearings.[12] "Lurgimetall" is a bearing alloy of lead and 2.8 percent barium, 0.4 percent calcium, and 0.3 percent sodium produced by Metallgesellschaft, A. G., Frankfurt, Germany.

Prices.—Calcium metal was quoted throughout 1946 at $1.85 a pound, in ton lots, cast in slabs and small pieces (apparently for 97–98 percent purity), according to E&MJ Metal and Mineral Markets. The metal was exempted from price control in August by Office of Price Administration Supplementary Order 129 as amended. The quotation for calcium-silicon (28–35 percent Ca, 60–65 percent Si, 6 percent max. Fe), lump, carlots, f. o. b. Welland, Ontario, decreased

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[7] Dean, R. S., and Silkes, B., Boron in Iron and Steel: Bureau of Mines Inf. Circ. 7363, 1946, 56 pp.
[8] Archer, Robert S., Boron in Steel: Metal Prog., vol. 50, No. 4, October 1946, pp. 677–686.
[9] Udy, M. C., and Rosenthal, P. C., Boron in Certain Alloy Steels: Am. Inst. Min. and Met. Eng., Metals Technol., vol. 13, No. 7, October 1946, Tech. Paper 2085, 29 pp.
[10] Loomis, C. C., The Production of Metallic Calcium by Thermal Reduction: Trans. Electrochem. Soc., vol. 89, 1946, pp. 207–216.
[11] Northern Miner (Toronto), Metal Hydrides Has Better Prospects: Vol. 33, No. 12, 1947, June 12, p. 5.
[12] Farnham, G. S., and Potvin, R., The Metallgesellschaft Research Laboratories, Some Aspects: Trans. Canadian Inst. Min. and Met., vol. 49, 1946, p. 508.

from 15½ cents a pound at the beginning of 1946 to 14½ cents by the end of the year.

Foreign Trade.—Of the calcium-silicon imports of 661,200 pounds in 1946, 594,000 were from Canada and 67,200 from France. There were no entries of calcium metal during the year.

Calcium metal and calcium-silicon imported for consumption in the United States, 1942–46 [1]

Commodity	1942		1945		1946	
	Pounds	Value	Pounds	Value	Pounds	Value
Calcium metal			17,086	$15,845		
Calcium-silicon	60,300	$10,144	164	22	661,200	$87,647

[1] No transactions reported during 1943 and 1944.

Canada.—Dominion Magnesium, Ltd., Haley's Station, near Ottawa, Ontario, produced 53,548 pounds ($68,720) of calcium metal in 1946 compared with 29,543 pounds in 1945. Production was interrupted during plant alterations in the latter part of 1946 but was planned to be resumed early in 1947. Calcium-silicon and calcium-manganese-silicon are produced by St. Lawrence Alloys & Metals, Ltd., Beauharnois, Quebec.

CERIUM AND OTHER RARE-EARTH METALS

Cerium master alloy (misch metal) has been produced from imported concentrates in the United States in recent years by Cerium Metals Corp., Niagara Falls, N. Y.; Cooper Metallurgical Laboratory, Cleveland, Ohio; Kent Metal & Chemical Works, Edgewater, N. J.; and New Process Metals Corp., Newark, N. J. The composition of the alloy is about 40–52 percent cerium; 22–30 percent lanthanum; 15–17 percent neodymium; 8–10 percent praseodymium, yttrium, samarium, and other rare-earth metals; and 0–5 percent iron. The master alloy is diluted to 15–40 percent iron content, and treated with small quantities of certain metals to improve its characteristics, in making ferrocerium for sparking "flints" of cigarette lighters, miners' lamps, and acetylene welding torches. There is some refining [13] of misch metal to yield pure cerium metal for radio tubes and nonferrous alloys. Additions of 4 to 10 percent cerium improve the properties of cast or forged magnesium at elevated temperatures.[14]

Imports of cerium alloys for consumption in the United States totaled 15,660 pounds ($80,276) in 1946 compared with 33,080 pounds ($151,963) in 1945. All the entries were from Canada. Exports of cerium metal and alloys were 39,718 pounds ($167,641) in 1946 and 32,175 pounds ($100,958) in 1945.

[13] Roots, E. F., Cerium and Thorium: Western Miner (Vancouver), vol. 19, No. 8, August 1946, pp. 50–56.
Hopkins, B. S., Electrochemistry of the Rare-Earth Group: Trans. Electrochem. Soc., vol. 89, 1946, pp. 295–300.

[14] Marande, R. F., Magnesium-Cerium Alloy Castings for High-Temperature Use: Materials & Methods, vol. 23, No. 2, February 1946, pp. 418–424.
Rote, F. B., Burgess, P. B., and Rustag, A. L., Production and Properties of Magnesium Press and Hammer Forgings: Office of Production Research and Development, War Production Board; section relating to cerium reprinted by Cerium Metals Corp., New York, 1946, 10 pp.

The Canadian producer of cerium alloys is Shawinigan Chemicals, Ltd., Shawinigan Falls, Quebec. In Korea, Nihon Magnesite KK, Joshin-Fu, Kankyo-hokudo, produced 50 metric tons of ferrocerium (averaging 70 percent Ce) in 1944 and 13 tons in the first 7 months of 1945.[15] The Treibacher Chemische Werke, A. G., Treibach, Austria, produced 222 metric tons of misch metal in 1940–44, and I. G. Farbenindustrie, Bitterfeld, Germany, had an output about 10 to 15 percent greater than that of the Treibach firm.[16] During 1946 the United Kingdom and Eire consumed 8,455 long tons of sulfuric acid (100 percent basis) in refining rare earths.[17] The Metal Bulletin (London) quoted cerium metal at £7¼ per pound, cerium alloy (52 percent) at 32 s. 6 d. per pound, and lanthanum metal (98–99 percent) at 15 s. per gram throughout 1946, except that the price of the alloy was increased to 36–38 s. during the final quarter.

Monazite—the principal source of cerium, other rare-earth metals, and thorium—and rare-earth compounds are discussed in the Minor Nonmetals and Uranium and Thorium chapters of this volume.

COLUMBIUM AND TANTALUM

Domestic Production.—No columbite was shipped from mines in the United States in 1946 and only 1,149 pounds in 1945. Shipments of tantalum concentrates were 3,475 pounds in 1946 compared with 5,500 pounds in 1945. Of the tantalum concentrated in 1946, microlite was produced by Arthur Montgomery, Harding mine, Dixon, Taos County, N. Mex., and tantalite by Mrs. George Hardesty, Hardesty Ranch mine, Pennington County, S. Dak., and Mineral Mills, Inc., Old Mike mine, Custer County, S. Dak. Development of microlite at the Harding mine[18] and at the Brown Derby group of claims, Gunnison County, Colo.,[19] was described. Ferrocolumbium is produced by the Electro Metallurgical Co., Niagara Falls, N. Y., and tantalum metal by the Fansteel Metallurgical Corp., North Chicago, Ill.

Columbium and tantalum concentrates shipped from mines in the United States, 1942–46

[Compiled by R. W. Metcalf]

Year	Columbium concentrates		Tantalum concentrates	
	Pounds	Value	Pounds	Value
1942			200	$175
1943	5,771	$1,465	9,411	27,621
1944	3,208	917	7,204	23,317
1945	1,149	287	5,500	13,366
1946			3,475	8,793

[15] Bardill, John D., Ferro-alloy Metallurgy of Japan: Bureau of Mines, Mineral Trade Notes, vol. 24, No. 5, special suppl. 14, May 1947, pp. 14, 39.

[16] Livingston, John A., and Kent, Henry, The Cerium Metal and Lighter Flint Industry in Germany and Austria: Off. of Military Govt. for Germany (US) FIAT Final Rept. 909, Sept. 30, 1946, 18 pp. (Pub. by U. S. Department of Commerce.)

Singer, R., Airey, H. E., Grimmett, L. C., Leech, H. R., and Bennett, R., The Cerium Industry in German Territory, Including Reports on Radium and Mesothorium: British Intelligence Objectives Subcommittee Final Rept. 400, Item 21, London, 1945, 102 pp.

[17] Chemical Age (London), vol. 56, No. 1442, Feb. 15, 1947, p. 258.

[18] Soulé, John H., Exploration of Harding Tantalum-Lithium Deposits, Taos County, N. Mex.: Bureau of Mines Rept. of Investigations 3986, 1946, 10 pp.

[19] Mining World, vol. 8, No. 5, April 1946, pp. 11–14.

Uses.—Columbium is added in quantities of 0.5–0.8 percent to stainless steel to improve weldability, creep strength, and impact strength. These steels together with new complex nonferrous alloys, some of which contain as much as 4 percent Cb, are used in making rotor wheels and blades for jet-propelled airplanes and in fashioning exhaust systems for both jet and internal-combustion aircraft engines.[20] A columbium nitride surface comprises the receiver in the bolometer, a heat-detecting device so sensitive that it can be used to determine range and bearing of objects in military operations and in navigation. Tantalum is utilized primarily as a getter in radio and radar tubes, as a catalyst for the manufacture of synthetic rubber, and as a constituent of carbide cutting tools.[21] It is also used in making aerial camera lenses, corrosion-resistant chemical equipment,[22] and skull plates and surgical wire.

Government Stocks.—The Office of Metals Reserve had 33,991 pounds of columbite on hand at the beginning of 1946 and 2,179 pounds at the end of the year. Its stocks of tantalite (averaging 41.3 percent Ta_2O_5) increased from 1,095,862 pounds to 1,125,004 pounds during 1946, and those of tantalum-columbium slag (9.2 percent Ta_2O_5) were unchanged at 3,460 short tons.

Prices.—In 1946, the principal consumer was offering about 55 cents per pound of contained Cb_2O_5 for columbite with a Cb:Ta ratio of 10:1, 50 cents for 4:1, and 45 cents for 2:1, c. i. f. New York. No minimum content columbium or maximum content of titanium or tin entered into the specification, but the percentage of columbium had to exceed that of tantalum. The Metal Bulletin (London) quoted columbite at 60 s. per unit of combined Cb_2O_5 and Ta_2O_5, c. i. f., in the first half of 1946 and 50–55 s. in the latter half of the year. The same journal quoted tantalum ore at £3½–£3¾ per unit at the beginning of 1946, £10 from late March until the end of June, and £7 in the second half of the year. Domestic prices for metals and alloys, according to E&MJ Metal and Mineral Markets, remained unchanged throughout 1946 as follows: Columbium metal, $500–$560 a kilogram ($227–$254 a pound). Ferro-columbium, 50–55 percent Cb, f. o. b. producer's plant, $2.25–$2.30 per pound of contained columbium. Tantalum metal, $143–$160.60 a kilogram ($65–$73 a pound).

Foreign Trade.—Imports of columbite are principally from Nigeria, and those of tantalite chiefly from Belgian Congo and Brazil, as shown in the accompanying table. Exports in 1946 were as follows: Columbite, 7,924 pounds ($3,566); columbium metal and alloys, 4,076 pounds ($5,296); tantalum concentrates, 21 pounds ($319); and tantalum metal and alloys, 494 pounds ($26,801).

[20] Badger, F. S., and others, Superalloys for High-Temperature Service in Gas Turbines and Jet Engines: Metal Prog., vol. 50, No. 1, July 1946, pp. 97–122.
Badger, W. L., Metallurgical Development of Materials for Turbosuperchargers and Aircraft Gas Turbines: Iron Age, vol. 158, No. 5, Aug. 1, 1946, pp. 60–66.
Binder, W. O., Alloys for High-Temperature Service: Iron Age, vol. 158, No. 19, Nov. 7, 1946, pp. 46–52.
Campbell, W. J., Welding Jet-Engine Parts: Iron Age, vol. 158, No. 10, Sept. 5, 1946, pp. 46–49.
Knight, Harold A., Super Alloys for High Temperature Service: Materials and Methods, vol. 23, No. 6, June 1946, pp. 1557–1563.
Schweizer, Carl I., Drop Forgings for Gas Turbine Applications: Materials and Methods, vol. 24, No. 3, September 1946, pp. 642–645.
Wilson, Thomas Y., High-Strength, High-Temperature Alloy S–816: Materials and Methods, vol. 24, October 1946, pp. 885–890.

[21] Brown, D. L., Tantung—What It is; How to Use It: Iron Age, vol. 158, No. 20, Nov. 14, 1946, pp. 76–81.

[22] Schrader, R. J., and DeHaan, A., Special Materials Solved Corrosion Problems at Oak Ridge: Chem. Eng., vol. 53, No. 11, November 1946, p. 100.

Columbium and tantalum ores (columbite and tantalite concentrates) imported for consumption in the United States, 1944–46, by countries, in pounds

Country	Columbium ore			Tantalum ore		
	1944	1945	1946	1944	1945	1946
Anglo-Egyptian Sudan				98		
Argentina				8,233		
Australia				9,315	21,125	500
Belgian Congo	1,373			332,312	485,986	263,097
Bolivia		1,034	[1] 6,834			
Brazil			7,717	440,460	68,229	98,072
Canada				700		
India	1,470			2,442		
Mozambique		22,046		4,751		
Nigeria	3,658,084	4,220,691	2,411,695	18,116	31,410	
Southern Rhodesia				12,794	9,967	
Uganda [2]	23,603	33,381		7,277	11,348	
Union of South Africa				632	2,027	1,884
Total: Pounds	3,684,530	4,277,152	2,426,246	837,130	630,092	363,553
Value	$1,196,899	$1,312,346	$742,804	$699,473	$453,141	$302,397

[1] Classified by U. S. Department of Commerce as from Chile, which is believed to have been the country of transshipment rather than country of origin.
[2] Classified by U. S. Department of Commerce as British East Africa.

World Review.—About 99 percent of the world columbite output is a byproduct of alluvial tin operations in Nigeria, where production totaled 1,550 long tons in 1946 compared with 1,571 tons in 1945.[23] The concentrates averaged about 65 percent Cb_2O_5. Amalgamated Tin Mines of Nigeria, Ltd., produced 773 long tons in the fiscal year ended March 31, 1947, compared with 583 tons in the year ended March 31, 1946. Jantar Nigeria Co., Ltd., produced 315 tons in the year ended September 30, 1946, compared with 373 tons in the year ended September 30, 1945. Bisichi Tin Co. (Nigeria), Ltd., produced 59½ tons in the calendar year 1946 and 100 tons in 1945. Brazil exported 7 metric tons of columbite in 1946, and Uganda exported 8 tons in 1945. The Bolivian Development Corp. reopened in 1945 the La Verde mine, near Santa Cruz, Bolivia (formerly worked for mica), and produced 3,116 kilograms of columbite in 1946. Malaya produced 5 tons of columbite during the Japanese occupation.[24] It is planned to open a deposit of columbite near Mayoko, French Equatorial Africa.[25] A columbium mine in the Ural Mountains, U. S. S. R., is being worked, and a concentrating plant was said to be under construction.[26]

The largest tantalite producer in the world is the Geomines company in the Belgian Congo; its output was 122 metric tons in the fiscal year 1945–46 compared with 128 tons in 1944–45 and 226 tons in 1940–41.[27] Brazil [28] exported 44 metric tons of tantalite in 1946 compared with 30 tons in 1945 and 254 tons in 1944. The Mines Department of Nigeria began in 1944 to stimulate tantalite production,[29] and output of the mineral in 1946 was valued at £1,333. Tantalum Industries Holdings Pty., Ltd., intends to build a tantalum refinery at

[23] Bureau of Mines, Mineral Trade Notes: Vol. 25, No. 3, September 1947, p. 6.
[24] Bureau of Mines, Mineral Trade Notes: Vol. 25, No. 4, October 1947, p. 15.
[25] Metal Bulletin (London), No. 3086, Apr. 12, 1946, p. 12.
[26] Foreign Commerce Weekly, vol. 22, No. 7, Feb. 16, 1946, p. 41.
[27] Metal Bulletin (London), No. 3173, Mar. 11, 1947, p. 12.
[28] Divisão de Fomento da Producão Mineral, Rio de Janeiro (Beryl-Tantalite Pegmatites of Paraiba and Rio Grande do Norte, Northeastern Brazil): Rept. 72, 1945, 85 pp.; (Geology of the Tantalum-Beryl Province of Borlorema): Rept. 73, 1945, 72 pp.; (Pegmatite Provinces of Brazil): Rept. 78, 1946, 76 pp.
[29] Hohnen, John H., Tantalite and Tantalum: Mining Mag. (London), vol. 74, No. 2, February 1946, pp. 77–82.

Finsbury, near Adelaide, South Australia. The company holds mineral leases in the Northern Territories and has obtained an option over the assets and leases of Tantalite, Ltd., in the Pilbarra and Greenbushes districts of Western Australia.[30] Tantalite production in Southern Rhodesia in 1946 was valued at £6,880.[31] Uganda exported 7 long tons (£3,240) of tantalite and bismutotantalite in 1945, and the Union of South Africa exported 2,000 pounds (£683) of tantalite in 1946. A 100-ton concentrator was installed in 1946 by Peg Tantalum Mines, Ltd., at Ross Lake, 45 miles northeast of Yellowknife, Northwest Territories, Canada.[32] It is intended that the concentrates will be treated for recovery of tantalum and columbium at a plant planned to be built by an affiliate, Tantalum Mining & Refining Corp. of America, at Edmonton, Alberta. Two other companies reportedly working tantalum properties in the Northwest Territories are De Steffany Beryllium Tantalum Mines, Ltd., Hearne Channel section, Great Slave Lake, and Laurence Lee Gold Mines, Yellowknife area.

GALLIUM

The Eagle-Picher Lead Co., Joplin, Mo., was the only producer of gallium in the United States in 1946. The Anaconda Copper Mining Co., Great Falls, Mont., produced several thousand grams in 1943–45 but had no output in 1946. The Bureau of Mines plans to investigate extractive processes on very low-grade domestic gallium-bearing material.

Gallium is the only metal other than mercury that is liquid at low temperatures but differs from the latter in having a high boiling point. These properties are useful in certain military devices, which will be designed to require gallium if a sufficient supply can be assured. Gallium is the filling in a thermometer for use up to 1,000° C. (1,832° F.).[33] It was employed by the Manhattan Project as a volatile "carrier" to sweep out impurities during uranium analyses.[34] The price of gallium during World War II was about $3 a gram. The metal was added October 17, 1946, to the Positive List of Commodities requiring license for export.

Germanite containing gallium occurs in the Mansfeld copper mines, Germany, and in the Tsumeb (Otavi) copper-lead mine, South-West Africa. The latter property was purchased by Tsumeb Corp., Ltd., a new American-British firm, in January 1947.

GERMANIUM

Germanium production in the United States reached an annual level of several hundred pounds for the first time in 1946. The entire output was by the Eagle-Picher Lead Co., Joplin, Mo., from cadmium fume obtained as a byproduct of sintering zinc concentrates. Distillation of the fume with hydrochloric acid yields germanium chloride, which is hydrolyzed with ammonium hydroxide and dried to the

[30] Chemical Engineering and Mining Review (Melbourne), Tantalum Metal To Be Produced in South Australia: Vol. 39, No. 1, Oct. 10, 1946, p. 14.
[31] Mining Journal (London), Annual Review Number, Apr. 30, 1947, p. 57.
[32] Northern Miner (Toronto), Peg Tantalum Mill Starts: Vol. 32, No. 37, Dec. 5, 1946, p. 16.
[33] Iron Age, Direct Reading Thermometer for High-Temperature Use: Vol. 158, No. 6, Aug. 8, 1946, p. 53.
[34] Chemical and Engineering News, Carrier-Distillation Analysis of Uranium: Vol. 25, No. 11, Mar. 17, 1947, p. 777.

oxide; the oxide can be reduced to metal by sodium cyanide, carbon, or hydrogen.[35] The germanium content of ores can be analyzed by a spectrochemical method.[36] Shipments of germanium in 1946 were principally in the form of oxide but also as metal and chloride.

High electrical resistance, expansion on solidification, and anti-corrosive properties are characteristic of germanium. The principal application is in electronic devices. It is also used as a catalyst in the hydrogenation of coal and is being alloyed experimentally with aluminum, magnesium, gold,[37] and platinum. The price during 1946 was about $180 a pound for the metal and $50 a pound for oxide. The Metal Bulletin (London) quoted metal, 99.5 percent, at 19s. per gram throughout the year.

Copper-lead ore from the Tsumeb (Otavi) mine, South-West Africa, has yielded a residue containing 3.8 percent Ge. The mine was shut down soon after the outbreak of World War II; but rehabilitation was begun following its purchase in January 1947 by Tsumeb Corp., Ltd., a new organization owned principally by Newmont Mining Corp. and the American Metal Co., Ltd.

INDIUM

The indium content of metal and compounds shipped by domestic producers was 9,667 troy ounces in 1946 compared with 57,434 ounces in 1945. A byproduct of zinc and lead operations, the indium was shipped in 1946 by the American Smelting & Refining Co., Perth Amboy, N. J., and Denver, Colo.; Anaconda Copper Mining Co., Great Falls, Mont.; Eagle-Picher Lead Co., Joplin, Mo.; and National Zinc Co., Inc., Bartlesville, Okla. The Perth Amboy plant was the only one of the five that produced indium in 1946. The principal distributor is the Indium Corp. of America, subsidiary of Anaconda Copper Mining Co. and Oneida, Ltd.

Plating indium on the lead coating of steel bearings and subsequently diffusing the indium into the lead at 350° F. considerably decreases galling. The indium improves corrosion resistance, permits bearing surfaces to retain a more complete oil film, and increases the strength of the surface into which it is impregnated.[38] Indium is also used in plating special alloys[39] and in making low-melting alloys and indium-zinc coatings. Laboratory experiments utilizing radioactive indium as a tracer were described.[40]

The price of indium metal, 99.9 percent was $2.25 a troy ounce throughout 1946, according to E&MJ Metal and Mineral Markets.

From Peru, the Cerro de Pasco Copper Corp., Oroya, exported 155,692 grams of indium in 1946 and 41,457 grams in 1945. Société

[35] Jaffee, Robert I., McMullen, E. W., and Gonser, Bruce W., Technology of Germanium: Trans. Electrochem. Soc., vol. 89, 1946, pp. 277–290.
[36] Marks, Graham W., and Hall, H. Tracy, A Method for the Spectrochemical Determination of Germanium, Tin and Lead in Ore Samples: Bureau of Mines Rept. of Investigations 3965, 1946, 38 pp.
[37] Jaffee, Robert I., and Gonser, Bruce W., Effect of Copper and Some Other Metals on the Gold-Germanium Eutectic: Am. Inst. Min. and Met. Eng., Metals Technol., vol. 13, No. 3, April 1946, Tech. Pub. 1998, 8 pp.
[38] Woldman, Norman E., Selecting Nonferrous Bearing Material: Iron Age, vol. 158, No. 10, Sept. 15, 1946, pp. 54–57.
[39] Halls, E. E., Indium Plating Aids Drawing of Aluminum Alloys: Metallurgia (London), vol. 33, No. 197, March 1946, pp. 243–245.
[40] Knox, K. L., and Spinks, J. W. T., Tracer Experiments with Radioactive Indium: Canadian Chem. and Process Ind., vol. 30, No. 11, November 1946, pp. 85–88.

Belgochimie is conducting research in Belgium to develop new applications for indium.[41]

LITHIUM

Lithium metal was produced in 1946 by Maywood Chemical Works, Maywood, N. J., and plans for output were made by Metalloy Corp., Minneapolis, Minn. Lithaloys Corp., New York, N. Y., filed a petition for reorganization June 3, 1946, and suspended operations. Nonelectrolytic methods of preparing metallic lithium were investigated by the National Research Corp., Boston, Mass.[42] The metal was under Government allocation from September 1, 1942, to October 1944 in accordance with War production Board Order M–191.

Lithium is added to copper-base alloy melts as a scavenger and is a minor constituent of certain nonferrous alloys. Lithium atmospheres in heat-treating furnaces prevent scaling (oxidation) and permit control of both carburizing and decarburizing.[43] Lithium peroxide and lithium borohydride can be used to generate oxygen and hydrogen, respectively. Lithium-aluminum hydride reduces organic compounds rapidly at room temperature in ether solutions, and its reactions are noteworthy for rapidity, cleanness, and increased yields compared with other reducing agents.[44] Lithium uses and methods of extraction in Germany were described.[45]

The price of lithium metal, 98–99 percent, 5-ton lots, was $12.50 a pound from January to mid November and $10 a pound during the remainder of the year, according to E&MJ Metal and Mineral Markets.

Ores and compounds of lithium are discussed in the Minor Nonmetals chapter of this volume.

RADIUM AND MESOTHORIUM[46]

Radium is produced as an accessory of uranium and vanadium from carnotite ores mined in Colorado and Utah,[47] but data on the quantities of ore produced and radium refined in recent years are not available for publication. Radium is used primarily in cancer treatment, dial painting, and radiographic inspection of heavy castings and welds. A new therapeutic use for radium is in the treatment of deafness, particularly of children and of war-injured airmen. Radium-alloy static eliminators are manufactured by the United States Radium Corp., New York, N. Y. Mesothorium—a radium isotope obtained from monazite residues—is used in radioactive dial paints also.

The number of radioactive specimens tested annually by the National Bureau of Standards gives some index as to demand. Such specimens contained 51.8 grams of radium and 0.3 gram of meso-

[41] Metal Bulletin (London), No. 3130, Sept. 24, 1946, p. 16.
[42] Industrial and Engineering Chemistry, ind. ed., vol. 38, No. 11, November 1946, pp. 8, 10.
[43] Burpo, Robert S., Jr., Some Users' Experience with Lithium Atmospheres for Heat Treating: Materials & Methods, vol. 24, No. 3, September 1946, pp. 622–625.
[44] Industrial and Engineering Chemistry, ind. ed., vol. 38, No. 12, December 1946, pp. 14, 16.
[45] Motock, George T., Extraction and Uses of Lithium in Germany: Bureau of Mines Inf. Circ. 7361, 1946, 23 pp. Reprinted from—Lithium Extraction and Uses: Off. of Military Govt. for Germany (US) FIAT Final Rept. 295, Oct. 3, 1945, 32 pp.
Smatko, Joseph S., The Lithium Electrolytic Cell (Degussa, Rheinfelden): Off. of Military Govt. for Germany (US) FIAT Final Rept. 786, Apr. 1, 1946, 8 pp. (Pub. by U. S. Department of Commerce.)
[46] Discussion of uranium, formerly included in this section, is to be found in the Uranium and Thorium chapter of this volume.
[47] Huleatt, W. P., Hazen, Scott W., Jr., and Traver, Willia n M., Jr., Exploration of Vanadium Region of Western Colorado and Eastern Utah: Bureau of Mines Rept. of Investigations 3930, 1946, 30 pp.

thorium in 1946 compared with 65.9 and zero grams, respectively, in 1945. Radium was quoted nominally at $25,000 to $30,000 a gram throughout 1946, according to Canadian Metals and Metallurgical Industries. Foreign trade in radium and mesothorium in recent years is shown in the accompanying table.

Radium salts and mesothorium salts imported for consumption and exported from the United States, 1942–46

Year	Imports				Exports				
	Radium salts			Radioactive substitutes [1] (value)	Radium salts			Mesothorium salts	
	Grams	Value			Grams	Value		Milligrams	Value
		Total	Average per gram			Total	Average per gram		
1942	23.043	$377,326	$16,400	$50	1.555	$57,352	$36,900	2	$8
1943	90.755	1,366,538	15,100	35,589	5.697	134,496	23,600	865	20,758
1944	101.290	1,374,933	13,600	128,010	4.752	120,086	25,300	----------	----------
1945	67.342	991,979	14,700	122,178	10.774	229,632	21,300	(2)	(2)
1946	17.229	326,450	18,900	----------	(2)	(2)	(2)	(2)	(2)

[1] Principally mesothorium.
[2] Not separately classified.

Geology, development, and milling at the uranium-radium mine at La Bine Point, east shore of Great Bear Lake, Northwest Territories, Canada—operated by Eldorado Mining & Refining Co., a crown company—were described.[48] Pitchblende concentrates from the Eldorado mine are shipped to the Government refinery at Port Hope, Ontario. During World War II the refinery was modernized from batch operation to continuous circuit. Union Minière du Haut Katanga exploits in the Belgian Congo one of the largest known uranium-radium deposits in the world. The company sold 80 to 150 grams of refined radium annually during the war.[49] Production at Jachymov (including some 10 percent at nearby Schmiedeberg), Czechoslovakia, in 1939–44 totaled about 110 metric tons of pitchblende concentrates containing approximately 175 milligrams of recoverable Ra per ton.[50] Two-thirds of that output was refined at Triebach, Austria, and one-third in Brunswick, Germany. The capacity of the Treibach plant is variously rated at 6–12 grams of radium annually, but output averaged only 3.5 grams yearly in 1936–44 owing to limited ore supplies. During that 9-year period the quantity of radium refined was 31.823 grams, of which 8.655 were from pitchblende, 7.413 from autunite, 0.250 from samarskite, 2.548 from "ore residues," 9.069 from "intermediate products," 2.579 from old carriers, and 1.309 from old neutron preparations. Mesothorium production at Treibach was 10.142 grams in 1936–44. The British Ministry of Supply plans to establish a national center for the processing and distribution of radium, radon (gaseous radioactive element 86, disintegration product

[48] Murphy, Richard, Howard, Henry, and other staff members, The Eldorado Enterprise: Trans. Canadian Inst. Min. and Met., vol. 49, 1946, pp. 423–438.
See also Senftle, Frank E., Relation of Conductivity and Total Solid Content of Lake Water to Its Radium Content, Great Bear Lake Region: Trans. Canadian Inst. Min. and Met., vol. 49, 1946, pp. 439–446.
[49] Metal Bulletin (London), No. 3113, July 23, 1946, p. 15.
[50] Singer, R., and others, work cited in footnote 16. The radium and mesothorium sections of that work were abstracted in Bureau of Mines Mineral Trade Notes, vol. 24, No. 1, January 1947, pp. 32–35.

of radium), and artificial radioactive substances.[51] The Ministry will purchase the radio chemical plant and business of Thorium, Ltd., Amersham, Bucks, England (except the manufacture of luminous compounds and other secondary products), take over from the Medical Research Council the extraction of radon, and receive from Johnson Matthey & Co., Ltd., the business of filling radium containers.

RHENIUM

Rhenium is produced by the Department of Chemistry, University of Tennessee, Knoxville, under the supervision of Prof. A. D. Melaven, from molybdenite roaster flue dust (0.4 to 1.5 percent Re) supplied by the Miami Copper Co., Miami, Ariz. The process involves agitating the flue dust in water, filtering off molybdenum sulfide, and treating the filtrate with potassium chloride to precipitate potassium perrhenate ($KReO_4$), which is reduced by hydrogen to metal. Production of potassium perrhenate by the university was 2 pounds in 1942, 12 pounds in 1943, 23 pounds in 1944, and none in 1945 or 1946. Delivery of new processing equipment was expected to result in an output of 150 to 200 pounds in the 1947–48 school year. One pound of perrhenate yields approximately 0.6 pound of metal.

No commercial applications for rhenium have yet become established. However, patents have been issued covering the use of rhenium and its alloys of tungsten, molybdenum, chromium, tantalum, and platinum-group metals in lamp filaments, electric contact points, thermocouples, corrosion-resistant alloys, catalysts, and pen-point nibs. Rhenium is silver-white, has a specific gravity of 21, and melts at about 3,100° C. The University of Tennessee sold rhenium during 1946 at the following prices, per gram:

	Potassium perrhenate	*Rhenium metal*
First 10 grams at	$2.00	$3.25
Next 90 grams at	1.50	2.50
Each gram over 100 grams	1.00	1.75

The cost of perrhenate was $8 a gram in 1942 to July 1943, $6 from August 1943 to March 1944, and $4 from August 1944 to December 1945. The corresponding figures for rhenium metal were $14, $10, and $6.50, respectively.

Vereinigte Kaliwerke Salzdetfurth A. G., Werk Hattorf, Phillipsthal, Germany, formerly treated potash residues (now exhausted) to yield potassium perrhenate, from which Deutsche Gold und Silber Scheideanstalt, Frankfurt-on-Main, produced about 200 kilograms annually of rhenium-metal powder (99.5 percent) during the middle 1930's.[52] The smelting of copper at Kupferschieferbauernde Gesellschaft, Mansfeld, yields a rhenium-bearing residue from which Gebruder Borchers A. G., Oker, near Goslar, attempted to produce rhenium. The metal was used in Germany primarily as a substitute for osmium and iridium in platinum alloys for fountain-pen points.[53]

[51] Chemistry and Industry (London), No. 41, Oct. 12, 1946, p. 376.
[52] Tyler, Paul M., Rare and Minor Metals: Off. of Military Govt. for Germany (US) FIAT Final Rept. 750, Mar. 1, 1946, pp. 11–12. (Pub. by U. S. Department of Commerce.)
[53] Hensel, F. R., Rhenium: Off. of Military Govt. for Germany (US) FIAT Final Rept. 697, Feb. 5, 1946, 4 pp. (Pub. by U. S. Department of Commerce.)

SELENIUM AND TELLURIUM

Domestic Production.—The 21-percent drop in production of refined copper, as a result of labor management difficulties, was reflected in a 36-percent decline in selenium output. Recovery of tellurium was virtually suspended as a result of weak demand and heavy stocks. Producers of refined selenium and tellurium are the American Smelting & Refining Co., Baltimore, Md.; International Smelting & Refining Co., Perth Amboy, N. J.; United States Metals Refining Co., Chrome, N. J.; and United States Smelting, Refining & Mining Co., East Chicago, Ind. Silver slimes containing selenium and tellurium are recovered by Phelps Dodge Refining Corp., Laurel Hill, Long Island, N. Y., and El Paso, Tex. All the selenium and most of the tellurium refined come from tank slimes of electrolytic-copper refineries; some tellurium is a byproduct of lead.

Salient statistics of elemental selenium and tellurium in the United States 1942–46, in pounds

Year	Selenium					Tellurium [1]		
	Production	Producers' shipments [2]	Producers' stocks at end of year	Imports [3]		Production	Producers' shipments [2]	Producers' stocks at end of year
				Pounds	Value			
1942	506,426	316,613	341,900	83,666	$127,004	224,132	98,798	145,700
1943	635,581	521,779	455,677	81,720	142,032	56,174	62,260	139,403
1944	485,446	423,906	517,217	97,800	170,582	69,025	45,323	163,105
1945	[4] 458,486	[4] 604,445	[4] 371,258	219,215	395,934	80,750	60,328	183,527
1946	291,103	405,226	257,135	475,081	806,205	3,765	38,523	148,769

[1] Includes tellurium content of small quantity of oxide.
[2] Bureau of Mines not at liberty to publish value.
[3] Includes selenium salts.
[4] Revised figure.

Uses.—Selenium is used in decolorizing clear glass, manufacturing rectifiers, making red cadmium sulfoselenide pigments, and improving the machinability of stainless steels and copper alloys. The use of selenium in German rectifiers was described.[54] Selenium and tellurium are added to rubber cable coverings to promote resistance to heat, oxidation, and abrasion and to increase resilience. Tellurium-lead work-hardens and is resistant to acids.[55] Tellurium-copper (0.5–1 percent Te) was used in the body of the magnetron—the British-invented device generating the very high frequencies essential to radar; the tellurium addition renders the metal free-machining, making possible "machine-made copper parts at high speed with increased accuracy and better finish, comparatively free from burrs, the thermal and

[54] Dauber, Lt. Harry, Selenium Dry Rectifier Developments: Off. of Military Govt. for Germany (US) FIAT Final Rept. 706, Jan. 26, 1946, 38 pp. (Pub. by U. S. Department of Commerce.)
Matthias, Lynn H., Some Characteristics of Selenium Rectifiers Prepared by the Vacuum Method: Off. of Military Govt. for Germany (US) FIAT Final Rept. 671, Jan. 7, 1946, 6 pp. (Pub. by U. S. Department of Commerce.)
Ranger, Richard H., Supplement to Selenium Rectifier Development in Germany: Off. of Military Govt. for Germany (US) FIAT Final Rept. 890, Aug. 19, 1946, 25 pp. (Pub. by U. S. Department of Commerce.)
Richards, E. A., and Thompson, L. E., The German Metal Rectifier Industry: British Intelligence Objectives Subcommittee Final Rept. 797, Item 21, c. 1946, 24 pp.
[55] Sanderson, L., Tellurium—Its Ores, Properties and Applications: Metallurgia (London), vol. 33, No. 198, April 1946, pp. 291–292.

electrical properties being little affected." [56] The chill depth of cast iron is increased by tellurium.[57]

Prices.—Selenium (black, powdered, 99.5 percent) and tellurium were quoted at $1.75 a pound throughout 1946, according to E&MJ Metal and Mineral Markets. The Metal Bulletin reported the London price steady also at 8s. 6d. a pound for selenium and 7s. a pound for tellurium.

Foreign Trade.—Imports of selenium and selenium salts for consumption in 1946 totaled 475,081 pounds—473,819 from Canada, 711 from United Kingdom, and 551 from Belgium. Data on imports of tellurium and exports of selenium and tellurium in 1946 are not available.

Canada.—Production of selenium in Canada was 521,867 pounds ($949,798) in 1946 compared with 379,187 pounds ($728,039) in 1945. Exports of selenium were 723,490 pounds ($1,261,205) in 1946 and 350,744 pounds ($385,369) in 1945. The Dominion output of tellurium was 15,848 pounds ($24,405) in 1946 compared with final figures of 484 pounds ($929) in 1945. The principal producer was Canadian Copper Refiners, Ltd. (subsidiary of Noranda Mines, Ltd.), Montreal East, Quebec;[58] and the other was Ontario Refining Co. (subsidiary of International Nickel Co. of Canada, Ltd.), Copper Cliff, Ontario.

Germany.[59]—The principal German producer of selenium during World War II was Norddeutsche Affinerie, Hamburg, which had an output of 16.5 metric tons in 1939, 4.1 in 1940, 4.0 in 1941, 5.3 in 1942, 5.8 in 1943, and 5.0 in 1944—largely from the anode sludges of refining foreign copper ores. Additional selenium was imported from Sweden. There was some tellurium production during the period, but consumption probably did not exceed 1 ton a year.

THALLIUM

Thallium output in the United States was affected by strikes at nonferrous smelters in 1946 and was only a fifth of the several thousand pounds produced in 1945. All domestic production was recovered by the American Smelting & Refining Co. from cadmium-containing flue dusts treated at Denver, Colo. Thallium has been used, principally in the form of sulfate, as a rodenticide and insecticide; the organic preparations "Antu" and "1080" have recently appeared as competitive products. Thallium depresses the freezing point of mercury for low-temperature measurements and is also an activator for fluorescent materials. Thallium bromoiodide crystals transmit wavelengths in the far infrared region and are thus valuable in detection and signaling devices.

Price control of thallium metal was lifted in February 1946; but nominal quotations, according to E&MJ Metal and Mineral Markets, remained at the 1945 level of $12.50 a pound from January to mid August 1946 and were then listed at $17.50 for the remainder of the year. Imports of thallium sulfate reported by Oil, Paint and Drug

[56] Mining Magazine (London), vol. 74, No. 4, April 1946, p. 202.
[57] Foundry Trade Journal (London), vol. 78, March 14, 1946, pp. 283–287.
[58] Schloen, J. H., and Elkin, E. M., Canadian Copper Refiners Montreal East Plant: Trans. Canadian Inst. Min. and Met., vol. 49, 1946, pp. 143–190.
[59] Tyler, Paul M., Rare and Minor Metals: Work cited in footnote 52, pp. 12–13.

Reporter in May–December 1946 totaled 25 cases, at least partly (probably entirely) from Europe. Canada produced 128 pounds of thallium in 1944 but none in 1945–46.

ZIRCONIUM

Domestic Production.—Zircon production in the United States in 1946, all in Florida, surpassed—and by a wide margin—the former record of 3,646 short tons in 1927. The bulk of the output is recovered with ilmenite and rutile from dune sands near South Jacksonville; operations are by the Humphreys Gold Corp. for the Rutile Mining Co. of Florida, subsidiary of Titanium Alloy Manufacturing Co. The only other domestic producer was Riz Mineral Co., which mined black sands near Vero Beach, Indian River County, Fla., and recovered zircon, rutile, and ilmenite in its concentrator at Melbourne, Brevard County, Fla.

Milling and Refining.—Mixed zircon-rutile-ilmenite concentrates imported from Australia are separated into their component minerals by the International Titanium Corp. (subsidiary of the American Rutile Corp. and Ventures, Ltd.), Carteret, N. J.; Orefraction, Inc., Pittsburgh, Pa.; and Titanium Alloy Manufacturing Co., Niagara Falls, N. Y. Zirconium ferrosilicon is produced by Electro Metallurgical Co. at Sheffield, Ala.; Niagara Falls, N. Y.; and Alloy, W. Va. Zirconium-copper is produced by the Beryllium Corp., Reading, Pa., and Metal Hydrides, Inc., Beverly, Mass. Zirconium metal is prepared by Foote Mineral Co., Philadelphia, Pa.; Metal Hydrides, Inc.; and Titanium Alloy Manufacturing Co.

Consumption and Uses.—Shipments of foreign and domestic zircon to consumers in the United States reached an all-time high of 20,555 short tons in 1946 compared with 15,988 tons in 1945. Use distribution in 1946, according to estimates by principal shippers, was as follows, in percentages: Refractories, 28; vitreous enamels, 25; electrical and chemical porcelains, 19; metal and alloys, 16; pottery glazes, 10; and miscellaneous, 2. Zirconium refractories were described [60] and their utilization in gas turbines suggested.[61] The impact resistance of steel is substantially improved by small additions of zirconium.[62] The pure metal is used in vacuum tubes, [63] flash bulbs, and pyrotechnics. Addition of 0.5–1 percent Zr to magnesium-base alloys profoundly refines the grain, permitting high-speed rolling and extrusion.[64] A lamp whose pin-point zirconium-oxide cathode emits a brilliant white light has been developed.[65]

Stocks.—Producers' and distributors' inventories of zircon (including zircon content of zirconium-titanium concentrates) dropped from 6,316 short tons at the end of 1945 to 5,059 tons at the end of 1946.

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[60] Materials and Methods, vol. 23, No. 3, March 1946, pp. 790, 792.
Geller, R. F., and others: Work cited in footnote 2.
Hess, Frederic O., Investigation of Pure Oxide Ceramic Materials Intended for High-Temperature and High-Stress Applications: Off. of Military Govt. for Germany (US) FIAT Final Rept. 924, Sept. 4, 1946, pp. 2–8. (Pub. by U. S. Department of Commerce).
[61] Thum, Ernest E., Critical Points: Metal Prog., vol. 50, No. 2, August 1946, p. 293.
[62] Halley, James W., Grain-Growth Inhibitors in Steel: Am. Inst. Min. and Met. Eng., Metals Technol., vol. 13, No. 4, June 1946, Tech. Pub. 2030, 11 pp.
[63] Espersen, George A., Zirconium for Electron Tubes: Foote Prints, vol. 18, No. 1, 1946, pp. 3–7.
[64] Ball, C. J. P., Outstanding Properties of Magnesium-Zirconium Alloys: Aluminum and Magnesium, vol. 3, No. 1, October 1946, pp. 20–21, 41; No. 2, November 1946, pp. 12–13, 15, 19.
Doan, J. P., and Ansel, G., Some Effects of Zirconium on Extrusion Properties of Magnesium-base Alloys Containing Zinc: Am. Inst. Min. and Met. Eng., Metals Technol. vol. 13, No. 8, December 1946, 18 pp.
[65] Iron Age, vol. 157, No. 17, Apr. 25, 1946. p. 54; vol. 158, No. 5, Aug. 1, 1946, p. 92.

Government stocks held by the Office of Metals Reserve declined during 1946 from 15,829 tons of baddeleyite and 2,581 tons of zircon on January 1 to 10,336 tons of baddeleyite and 2,251 tons of zircon on December 31.

Prices.—Zirconium ore, 55 percent ZrO_2, f. o. b. Atlantic seaboard, was quoted nominally at $60–$70 during the first 5 months of 1946, $45–$47 in June to October, and $42–$45 in the two last months of the year according to E&MJ Metal and Mineral Markets. Zirconium ferrosilicon was quoted throughout the year at $102.50–$107.50 a long ton for 12- to 15-percent Zr content and 14–16 cents a pound for 35–40 percent Zr. Powdered zirconium metal was listed at $7 a pound.

Foreign Trade.—Zircon imports are almost exclusively from Australia, and baddeleyite entries are entirely from Brazil. Exports comprised 259 short tons ($17,285) of zirconium concentrates and 2,377 pounds ($6,122) of metal and alloys in 1946 compared with 108 tons ($7,126) of concentrates and 30 tons ($15,383) of metal and alloys in 1946.

Zirconium concentrates imported for consumption in the United States, 1942–46, by countries, in short tons [1]

Year	Zircon				Baddeleyite from Brazil	Accessory titanium minerals [3]	Total zirconium concentrates [4]	
	From Australia	From Brazil	Other [2]	Total			Short tons	Value
1942	11,145	----	196	11,341	15,283	7,282	33,906	$816,364
1943	11,472	110	----	11,582	8,821	8,009	28,412	697,704
1944	11,317	(5)	----	11,317	[5] 2,332	10,384	24,033	576,299
1945	17,138	(5)	6	17,144	[5] 792	8,534	26,470	554,400
1946	11,535	(5)	4	11,539	[5] 2,431	2,844	16,814	453,458

[1] Totals and country break-down by the U. S. Department of Commerce. Mineral break-down by Bureau of Mines.
[2] From India, 1942; French West Africa (Senegal), 1945; Canada, 1946.
[3] Rutile and ilmenite content of mixed zirconium-titanium concentrates imported from Australia.
[4] Classified as "ore" by U. S. Department of Commerce.
[5] Any zircon imports from Brazil, 1944–46, included with baddeleyite.

Technology.—Methods of preparing ductile zirconium by the Bureau of Mines [66] and of zirconium oxide and halides by Auergesellschaft Aktiengesellschaft, Berlin,[67] were described.

World Review.—World production of zirconium concentrates was estimated at 25,000 short tons in 1946. Australia produced 6,400 short tons (principally contained in zirconium-titanium concentrates) in 1945 compared with 15,680 tons in 1944. Output was from the 50-mile stretch of beach between Byron Bay, New South Wales, and Southport, Queensland.[68] Brazil exported 4,453 metric tons of baddeleyite (possibly including some zircon) in 1946 compared with 758 tons in 1945 and 2,152 tons in 1944. Enormous tonnages of ilmenite and smaller quantities of rutile, zircon, and monazite are recovered

[66] Kroll, W. J., Schlechten, A. W., and Yerkes, L. A., Ductile Zirconium from Zircon Sand: Trans. Electrochem. Soc., vol. 89, 1946, pp. 263–276.
Chemical Engineering, Zirconium Pilot Plant to Operate Soon: Vol. 53, No. 10, October 1946, pp. 184, 186.
[67] Ivory, Lt. Col. W., The Manufacture of Zirconium-Potassium Fluoride, Zirconium Oxide and Zirconium Oxychloride: British Intelligence Objectives Subcommittee Final Rept. 896, Item 22, c. 1945, 6 pp.
[68] Chemical Engineering and Mining Review (Melbourne), Recovery of Rutile and Zircon from Beach Sands: Vol. 38, No. 456, Sept. 10, 1946, pp. 451–454.

rom beach sands along the Malabar Coast, Travancore, India.[69] The Travancore Government has assumed control of mining, processing, and exporting.[70] Imports of zirconium concentrates by the United Kingdom totaled 656 long tons in 1940–44.[71] Zircon is mined near Mariupol in the Ukraine, U. S. S. R.[72] The Soviet practice of oxygenizing blast furnaces has increased the demand for zircon refractories.[73] Malaya produced 741 long tons of zircon and 207 tons of mixed monazite-zircon concentrates during the Japanese occupation.[74] Small quantities of zircon are produced from time to time in Egypt, Italy, Korea, Madagascar, and Senegal. Deutsche Gold und Silber Scheideanstalt, Frankfurt-on-Main, Germany, produced 47,956 kilograms of zirconium metal during World War II,[75] and Tokushu Kinzoku KK, Sakai, Osaka, made about 6 tons of ferrozirconium (40 percent) in 1944–45 from Korean river sands.[76]

[69] Viswanathan, P., Beach Minerals of Travancore: Science and Culture (Calcutta), vol. 12, No. 1, 1946, pp. 22–27.
[70] Mining Journal (London), vol. 227, No. 5802, Nov. 2, 1946, p. 868.
[71] Metal Bulletin (London), No. 3119, Aug. 16, 1946, p. 12.
[72] Mining Journal (London), vol. 225, No. 5753, Nov. 24, 1945, p. 797.
[73] Cass, W. G., World-Wide Chemistry—Russia: Chem. and Eng. News, vol. 24, No. 8, Apr. 25, 1946, p. 1123.
[74] Bureau of Mines, Mineral Trade Notes: Vol. 25, Nov. 4, October 1947, p. 14.
[75] Potvin, Roger, and Farnham, G. S., Producing Zirconium and Titanium in Germany: Trans. Canadian Inst. Min. and Met., vol. 49, 1946, pp. 516–524.
[76] Bardill, John D., Ferro-alloy Metallurgy of Japan: Bureau of Mines, Mineral Trade Notes, vol. 24, No. 5, Special Suppl. 14, May 1947, p. 38.

Minor Nonmetals

By G. RICHARDS GWINN [1]

	PAGE		PAGE
Graphite	1285	Olivine	1293
Greensand	1287	Perlite	1294
Kyanite, andalusite, dumortierite, and sillimanite	1288	Radio-grade quartz	1295
Lithium minerals	1289	Strontium minerals	1296
Mineral earth pigments	1290	Topaz	1297
Mineral wool	1292	Vermiculite	
Monazite	1293	Wollastonite	1298

GRAPHITE

PRODUCTION of crystalline and amorphous graphite in 1946 was 14 percent greater than 1945, but sales were 9 percent below the 1945 total. There are too few domestic producers to show separate statistics on amorphous and on crystalline graphite. The accompanying table shows combined figures for the 1942–46 period. Producers' stocks totaled 949 short tons at the end of 1946. Manufactured graphite was produced by several companies during 1946, but production figures are not available for publication. The manufactured material competes with natural graphite in many uses. Among them are: Self-lubricating bearings, mold wash in steel mills, pencils, crayons, paint, polishes, and powder glazing.

Production and shipments of natural graphite in the United States, 1942–46

Year	Production (short tons)	Shipments		Year	Production (short tons)	Shipments	
		Short tons	Value			Short tons	Value
1942	7,120	7,253	$401,690	1945	4,888	5,334	$299,207
1943	9,939	9,597	903,102	1946	5,575	4,844	252,596
1944	5,408	5,768	349,663				

Total imports of graphite were less than in the previous year. No shipments of powdered or dust graphite were received, and imports of carbon lump from Ceylon were greatly reduced. Although the quantity of crystalline flake received from Madagascar was greater than in 1945, it fell far short of demands. Labor troubles, fluctuations in the Metropolitan and Malagasy (Madagascan) franc, and a serious

[1] Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

landslide at one of the large mines caused almost a complete cessation of activities in the Madagascar graphite mines during part of 1946. A new and higher scale of prices effective January 17, 1947, will, it is believed, effect a large increase in output from Madagascar mines in 1947. The decrease in Ceylon imports is attributed to smaller requirements. Imports for the 1942–46 period are summarized in the following table.

Graphite (natural and artificial) imported for consumption in the United States, 1942–46

Year	Crystalline				Amorphous				Total	
	Flake		Lump, chip, or dust		Natural		Artificial			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1942	6,031	$412,919	4,152	$601,150	33,569	$1,480,079	169	$4,739	43,921	$2,498,887
1943	5,311	493,382	1,012	117,795	22,390	331,800	205	15,515	28,918	958,492
1944	6,191	663,231	1,568	251,832	18,294	345,612	131	10,299	26,184	1,270,974
1945:										
Brazil					33	3,638			33	3,638
Canada	101	25,120			1,178	92,308	154	6,223	1,433	123,651
Ceylon			1,324	187,771	842	118,020			2,166	305,791
Madagascar	2,782	261,412	3,883	370,471					6,665	631,883
Mexico					25,879	350,063			25,879	350,063
Mozambique					110	5,571			110	5,571
	2,883	286,532	5,207	558,242	28,042	569,600	154	6,223	36,286	1,420,597
1946:										
Brazil					1	75			1	75
Canada	113	24,524			1,413	117,276	4	558	1,530	142,358
Ceylon			56	7,990	3,674	482,899			3,730	490,889
Cuba					1	50			1	50
France	24	5,133							24	5,133
India and dependencies					168	18,086			168	18,086
Madagascar	3,200	223,506							3,200	223,506
Mexico					24,389	441,189			24,389	441,189
Mozambique					96	5,980			96	5,980
Switzerland					1	280			1	280
	3,337	253,163	56	7,990	29,743	1,065,835	4	558	33,140	1,327,546

Crucible-grade flake graphite and high-carbon flake and amorphous graphite are included in the list of strategic minerals that must be stock-piled for national defense.

Exports of natural graphite, 1942–46, were—1942: 4,095 short tons, valued at $413,281; 1943: 3,010 tons, $317,586; 1944: 2,230 tons, $248,257; 1945: 1,308 tons, $134,414; 1946: 2,313 tons, $267,137.

Trade-journal quotations of prices for graphite f. o. b. New York in 1946 were: Ceylon lump, 10–12 cents per pound; carbon lump, 9–10 cents; dust, 4–5 cents; Madagascar No. 1 flake, 9–16 cents; No. 2, 7 cents upward; fine ground, 55 to 70 percent carbon, 3 cents upward. Crude amorphous graphite was $14 to $30 per ton, according to grade. All prices nominal.

World production figures for graphite for the 1915–39 period were published in Minerals Yearbook, Review of 1940 (p. 1414). The accompanying table shows available statistics for 1938–46.

World production of natural graphite, 1938–46, by countries, in metric tons[1]

[Compiled by B. B. Mitchell]

Country[1]	1938	1939	1940	1941	1942	1943	1944	1945	1946
Argentina	28	------	100	135	244	237	455	(2)	(2)
Australia:									
New South Wales	------	------	41	64	3	114	142	51	(2)
Queensland	10	------	63	320	225	360	52	58	(2)
South Australia	------	------	------	50	71	88	253	5	(2)
Tasmania	------	------	5	5	------	7	------	------	(2)
Western Australia	------	------	1	(3)	6	11	------	------	(2)
Austria	16,852	24,013	22,991	24,264	26,203	31,305	24,617	3,483	(2)
Brazil (exports)	------	------	------	60	72	19	199	131	92
Bulgaria	------	23	50	(2)	(2)	(2)	(2)	(2)	(2)
Canada	[4] 1,044	[4] 1,199	[4] 1,381	[4] 905	[4] 463	1,726	1,435	1,733	1,792
Ceylon (exports)	11,972	22,756	24,414	27,670	27,872	20,830	12,461	7,946	2,356
China	[5] 1,400	[5] 2,000	17,400	16,900	16,860	(2)	(2)	(2)	(2)
Czechoslovakia	5,919	7,669	10,725	8,694	13,126	21,252	21,459	(2)	(2)
Egypt	------	------	------	------	------	------	260	152	------
Germany: Bavaria	28,106	28,180	29,891	29,771	33,316	34,960	36,357	(2)	(2)
India	465	951	311	827	1,072	1,152	943	1,312	(2)
Indochina	------	------	------	2	14	25	30	(2)	(2)
Italy	5,485	5,715	4,996	4,136	5,483	(2)	(2)	1,793	(2)
Japan	1,399	1,530	2,088	3,393	2,866	7,791	10,382	12,449	11,339
Korea (Chosen)[4]	57,318	83,415	94,273	68,640	96,054	96,471	103,306	------	(2)
Madagascar	14,545	12,196	15,311	13,018	9,562	12,949	14,478	9,185	[4] 8,875
Mexico	9,611	9,815	12,327	16,928	20,811	20,677	12,977	23,634	21,949
Morocco:									
French	307	886	529	571	1,067	265	213	262	637
Spanish	73	(3)	352	414	888	226	42	100	(2)
Norway	3,802	4,333	2,646	3,588	2,933	3,178	3,784	(2)	(2)
Portuguese East Africa	(2)	(2)	(2)	(2)	165	428	(2)	(2)	(2)
South-West Africa	------	------	71	188	181	1,758	1,973	1,477	762
Spain	------	54	353	23	251	136	1,050	2,528	(2)
Sweden	192	549	153	205	174	171	------	802	(2)
Union of South Africa	54	59	78	74	335	55	130	128	180
United States:									
Amorphous	(6)	(6)	(6)	2,493	6,459	9,016	4,906	4,434	5,058
Crystalline	(6)	(6)	------						
Total[1]	159,000	205,000	241,000	223,000	267,000	286,000	271,000	158,000	(2)

[1] In addition to countries listed graphite is produced in France, Greenland, Kenya, Nyasaland, and U. S. S. R. but production data are not available.
[2] Data not available; estimate included in total except for 1946.
[3] Less than 1 ton.
[4] Exports.
[5] Data represents areas designated as Free China during the period of Japanese occupation.
[6] Bureau of Mines not at liberty to publish figures.

GREENSAND

Production of greensand by three companies in New Jersey in 1946 reached 5,045 short tons; shipments totaled 5,140 tons valued at $424,900 compared to an output of 4,738 tons and shipments of 4,986 tons valued at $477,919 in 1945. All material shipped in 1946, as in the previous year, was utilized in the manufacture of water-softening compounds and water-purification agents. Greensand was released from price control on July 26, 1946, under amendment 36 of Office of Price Administration Supplementary Order 129.

Statistics for greensand sold or used are shown in the accompanying table.

Greensand marl sold or used by producers in the United States, 1942–46

Year	Short tons	Value	Year	Short tons	Value
1942	10,110	$448,440	1945	4,986	$477,919
1943	10,056	522,124	1946	5,140	424,900
1944	4,908	505,651			

KYANITE, ANDALUSITE, DUMORTIERITE, AND SILLIMANITE

Domestic production of kyanite reached an all-time high in 1946. Imports of kyanite from India were less than in the previous year because of transportation problems in that country. Minor amounts also were received from British East Africa and the Union of South Africa. The receipt of 592 short tons of sillimanite valued at $13,856 from Australia was also reported. Available statistics for recent years are summarized in the following table.

Statistics on the domestic kyanite industry have not been released since 1943, because there have been too few producers to allow publication of the figures. Shipments of domestic kyanite for the 1940–43 period were published in Minerals Yearbook, 1943 (p. 1579).

Consumption and stocks of imported kyanite in the United States, 1942–46

	Imports		Consumption (short tons)	Stocks Dec. 31 (short tons)
	Short tons	Value		
1942: India	6,524	$93,743	[1] [2] 8,024	[1] 9,500
1943: India	9,972	105,042	[1] [2] 8,416	[1] 11,000
1944:				
British East Africa	55	591	[3]	[3]
India	5,680	66,850	[3]	[3]
	5,735	67,441	[1] 8,064	[1] 8,600
1945:				
British East Africa	560	7,000	[3]	[3]
India	13,994	160,997	[3]	[3]
	14,554	167,997	[4] 15,000	[4] 8,000
1946:				
British East Africa	395	3,308	[3]	[3]
India	10,110	109,990	[3]	[3]
Union of South Africa	277	3,187	[3]	[3]
	10,782	116,485	[4] 11,500	7,280

[1] Consumption and stocks as reported by WPB for 1942–44.
[2] Includes 154 tons in 1942 and 316 tons in 1943 reexported to Canada.
[3] Data not available.
[4] Partly estimated.

Production of kyanite in 1946 was reported by the Kyanite Mining Corp., near Farmville, Va.; the Vitrefrax Corp., near Ogilby, Calif; and the A. P. Green Firebrick Co., of Mexico, Mo., from a deposit near Clarksville, Ga. The Kyanite Mining Corp., by far the largest producer, is the only company selling on the open market.

Kyanite minerals were released from price control under Amendment 36 of Office of Price Administration Supplementary Order 129, on July 26, 1946. Prices of domestic kyanite in 1946 ranged from $19 per short ton for crude kyanite to $37.50 for calcined concentrate, 35-mesh, in carlots. The cost of Indian kyanite laid down at Atlantic seaports in 1946 was about $22 per short ton.

Because of relatively large stocks on hand and small requirements, Champion Sillimanite, Inc., the only domestic producer, did not operate its andalusite mine in Mono County, Calif., or its dumortierite mine in Pershing County, Nev.

Laboratory and pilot-plant work on the sillimanite schists in the

Southeastern States is still in progress. A review of the Bureau of Mines, work on these deposits has recently been released.[2]

Separate classification of exports of kyanite and associated minerals was started in 1945. Exports for that year totaled 307 short tons valued at $20,205. The markets were Canada, Mexico, Argentina, Brazil, and Nicaragua. Exports in 1946 reached 342 short tons valued at $17,881 and the Netherlands, China, and the United Kingdom were added to the export market. The bulk of the material exported in both years, however, was purchased by Canada.

LITHIUM MINERALS

Production of all kinds of lithium raw materials in 1946, with the exception of amblygonite, was greater than in 1945. The American Potash & Chemical Corp. at Searles Lake, Calif., was again by far the largest producer.

The Hayden Mining Co., of Colorado Springs, Colo., the only domestic producer of lepidolite, operated the Pidlite mines in San Miguel County and the Harding mine in Taos County, N. Mex., as well as the Brown Derby mine in Gunnison County, Colo.

The tonnage and value of lithium ores and compounds shipped in recent years and the approximate Li_2O content are shown in the accompanying table.

Although far below the volume of the recent wartime output, shipments in 1946 were 131 percent above the 1935–39 average, and the Li_2O content was 267 percent greater.

Shipments of lithium ores and compounds from mines in the United States, 1935–39 (average) and 1942–46

Year	Ore (short tons)	Value	Li_2O (short tons)	Year	Ore (short tons)	Value	Li_2O (short tons)
1935–39 (average)	1,327	$48,280	88	1944	13,319	$552,977	848
1942	5,405	243,516	299	1945	2,446	285,520	274
1943	8,155	314,660	463	1946	3,065	303,892	323

Several new uses for lithium compounds were reported in 1946. They were: Lithium peroxide, a solid of high stability containing about 35 percent of available oxygen by weight; lithium borohydride, a solid stable in dry air and capable of generating 66 cubic feet of hydrogen per pound on contact with water; and lithium diborane, a gas which at room temperature liberates 88 cubic feet of hydrogen per pound on contact with water. The Texas Co., 135 East 42d St., New York, announced a new synthetic low-temperature grease with a lithium base which is stable in temperatures from −100° to +300° C.

A new reducing agent, lithium aluminum hydride, has also recently been announced. This new material, first made in June 1945, bids fair to win an important place as a research and industrial tool in organic and inorganic chemistry. It will be of particular aid in the

[2] Hudson, W. C., Exploration of Georgia and South Carolina Sillimanite Deposits: Bureau of Mines Rept. of Investigations 3927, 1946, 44 pp.

reduction of unsaturated compounds, since it apparently does not attack the carbon-to-carbon double bond.[3]

The Bureau of Mines has recently issued a report on the lithium industry in Germany with particular reference to activity during the latter part of World War II.[4]

Trade-journal prices of lithium ores were as follows: Spodumene, $5 to $6 per 20 pounds of contained Li_2O on 6 percent grade, carlots; amblygonite, 8 to 9 percent Li_2O, $40 to $50, per short ton f. o. b. mine; and lepidolite, 3 percent Li_2O, $24 to $25 per short ton, f. o. b. mine. The price of dilithium sodium phosphate was reported at about $230 per ton.

MINERAL EARTH PIGMENTS

[By Charles L. Harness]

The construction boom in 1946 placed severe demands on paint materials of all kinds, and the earth pigments shared the rising market with lead, zinc, and titanium pigments. Total sales of mineral earth pigments were 14 percent greater than that reported in 1945.

Synthetic earth pigments accounted for 33 percent of the total tonnage and 54 percent of the total value. This is a substantial increase over the 3 percent of tonnage recorded by the Bureau of the Census in 1921 and the 11 percent noted by the same agency in 1927.

Among the German pigment developments described by a team of American technical experts was the manufacture of black and yellow iron oxide pigments as byproducts in the reduction of nitrobenzene to aniline. The report[5] also describes the production of red iron oxide pigments from iron carbonyl and a magnetic brown oxide, suitable for use in the plastic tape of magnetophone sound reproduction units.

Of particular interest to the American paint industry in 1946 was the trend of imports of foreign earth pigments. Italian siennas, Turkey umbers, French ochers, and Spanish red oxide were received in small but significant quantities, and the flow will probably be greater when more containers are available in the countries of origin. It seems likely that imports of Spanish red oxide and Turkey umber will regain a substantial portion of their prewar American markets. Siennas and ochers, on the other hand, may meet stronger competition from American synthetic pigments.

Production of Spanish red oxide was 4,242 metric tons in 1945 and 1,572 tons in 1946.[6] Half the output was shipped to the United States, and the remainder principally to Argentina, Spain, Portugal and Sweden.

[3] Ind. Eng. Chem., vol. 38, No. 12, 1946, pp. 14-16.
[4] Motock, G. T., Extraction and Uses of Lithium in Germany: Bureau of Mines Inf. Circ. 7361, 1946, 23 pp.
[5] Love, Charles H., German Production of Some of the More Important Inorganic Pigments: Office of Military Government for Germany (US), FIAT Final Rept. 814, 1946, 79 pp. (Published by U. S. Department of Commerce).
[6] Bureau of Mines, Mineral Trade Notes: Vol. 23, No. 4, October 1946. pp. 35-36.

Prices of finished earth pigments, which are quoted in cents per pound, barrels, works, were generally unchanged during 1946, according to the Oil, Paint and Drug Reporter. Precipitated magnetic blacks were quoted at 8½; metallic brown was 2½; synthetic (pure) browns, 12; burnt siennas, American type, 6½ to 8; Italian-type burnt siennas, 8¾ to 9¾; American-type raw siennas, 4 to 10; raw siennas, Italian type, 8 to 10; Turkey-type umbers, 4¾ to 5⅞, depending on point of purchase; Vandyke brown, regular, 9; sap brown (special Vandyke brown) 12; synthetic (pure) red iron oxides, 9 to 9¾; Venetian reds, 2.2 to 4, depending on iron oxide content; natural (metallic) red oxide, 2; natural yellow oxides, high iron, 4¼; synthetic (pure) iron oxide yellows, 6.85; and French-type ochers, 8.45.

Natural mineral pigments and manufactured iron oxide pigments sold by processors in the United States, 1945–46, by kinds

Pigment	1945		1946	
	Short tons	Value	Short tons	Value
Mineral blacks	2,960	$61,388	6,369	$118,171
Precipitated magnetic blacks	(1)	(1)	(1)	(1)
Natural brown oxides (metallic browns)	6,569	290,011	5,823	276,379
Vandyke brown (finished pigment)	284	52,084	(1)	(1)
Sap brown				
Pure browns (96 percent or better iron oxides)	(1)	(1)	1,018	206,806
Natural red oxides	18,051	714,856	22,436	972,405
Pure red oxides (98 percent or better Fe_2O_3)	13,347	2,457,565	17,050	3,117,706
Venetian reds	8,954	650,815	9,727	721,354
Pyrite cinder	679	42,545	964	52,471
Other red iron oxides	11,064	1,050,695	17,345	1,683,166
Natural yellow oxides (high Fe_2O_3)	(1)	(1)	(1)	(1)
Pure yellows (85 percent or better Fe_2O_3)	14,060	1,913,609	8,505	1,178,825
Ochers (low Fe_2O_3)	11,018	361,441	12,505	286,322
Siennas:				
Burnt	853	109,498	1,197	168,978
Not burnt	2,563	306,621	2,401	303,483
Umbers:				
Burnt	2,685	232,899	3,727	325,856
Not burnt	(1)	(1)	916	68,615
Other	7,927	581,147	5,114	523,613
	101,014	8,825,174	115,097	10,004,150

[1] Included under "Other."

Selected mineral pigments imported for consumption in the United States, 1943–46

Pigment	1943		1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Iron oxide pigments:								
Natural	581	$22,051	1,494	$61,231	2,837	$125,370	5,423	$318,239
Synthetic	800	92,966	686	86,188	439	58,380	759	106,302
Ocher, crude and refined	78	1,810	4	221	784	36,608	167	6,528
Siennas, crude and refined							755	73,129
Umber, crude and refined			1,172	31,599	1,989	57,281	3,134	95,815
Vandyke brown							101	10,432
	1,459	116,827	3,356	179,239	6,049	277,639	10,339	610,445

Dry ocher, sienna, umber, and other forms of iron oxide for paint exported from the United States, 1943–46, by countries

Country	1943		1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Argentina	34	$7,510	19	$5,837	1	$721	55	$11,340
Belgian Congo	42	4,298	40	4,106	50	6,450	22	2,402
Belgium and Luxembourg							201	30,886
Bolivia	34	6,999	10	1,414	(1)	88	15	2,618
Brazil	66	14,618	249	54,287	139	18,054	304	58,265
Canada	2,660	198,296	3,333	194,489	3,484	285,177	3,279	327,328
Chile	81	18,776	90	19,656	30	10,962	28	4,980
China	3	860					147	25,219
Colombia	165	39,401	137	30,777	93	21,728	181	40,654
Cuba	314	44,751	238	32,198	386	55,859	410	48,649
Curaçao (N. W. I.)	59	29,077	10	937	5	893	6	1,398
Mexico	283	59,428	220	44,004	165	33,870	136	31,660
Netherlands							198	13,353
Panama, Republic of	69	4,476	120	8,937	71	7,584	45	6,420
Peru	39	4,707	61	8,621	23	5,653	41	7,957
Portugal	78	3,154	160	6,488	195	8,648	125	7,660
Sweden					131	9,006	103	18,468
Union of South Africa	6	532			11	2,841	52	25,742
Venezuela	94	18,649	112	17,407	130	31,799	187	35,704
Other countries	343	48,791	360	55,692	302	52,553	552	93,419
	4,370	504,323	5,159	484,850	5,216	551,886	6,087	794,117

[1] Less than 1 ton.

MINERAL WOOL

The most recent mineral-wool production statistics available are those for 1944. Figures for the 1942–44 period were published in Minerals Yearbooks, 1943 and 1944, on pages 1583 and 1541, respectively. The mineral-wool canvass was transferred to the Bureau of the Census in 1945, but no statistics have been compiled. It is estimated, however, that the combined production of home and industrial insulation in 1945 was approximately 720,000 short tons valued at $70,000,000, and the 1946 total is believed to be 20 percent above the 1945 figure.

Insulation has become virtually an essential element of dwelling construction and not just a temporary measure for fuel conservation during times of war. A review of the advantages to the home owner of insulation with mineral products has recently been released by the Bureau of Mines.[7]

The mineral-wool industry expanded substantially in 1946. Several new plants began operations, many existing plants added equipment, and others were in the process of construction. Among the new plants are the Everock Products Co., at Tacoma, Wash., which features a modern induction-type electric furnace instead of the conventional water-jacketed cupola used in most plants; Independent Insulations, Inc., also at Tacoma, has a daily capacity of 40 tons, which it expects to increase to 200 tons. The Weathermaster Manufacturing Co., at Tonganoxie, Kans., and the Owens-Corning Fiberglas Co., at Kansas City, Kans., also began operation in 1946. Additional plants are either in the planning or construction stage in California, Ohio, Oklahoma, Texas, and Washington.

[7] Bowles, O., Home Insulation With Mineral Products—Conserves Fuel—Reduces Cost—Increases Comfort: Bureau of Mines Inf. Circ. 7388, 1946, 11 pp.

The commercial standard for Industrial Mineral Wool, All Types—Testing and Reporting, presented by the Industrial Mineral Wool Institute in 1945 and prepared by the National Bureau of Standards, was accepted by the trade and became effective on March 15, 1946, as Commercial Standard CS 131–46.[8]

MONAZITE

Monazite contains thorium—a source material for atomic energy—and thus very little material on the current uses and output can be published. The quantity and value of the monazite sand imported in 1946 therefore cannot be released. Import figures covering the 1936–45 period, as well as Government regulations pertaining to thorium, are contained in the Uranium and Thorium chapter of this volume.

Although there are large deposits of monazite in Brazil, the current producing and concentrating capacity is not adequate for our needs. A review of the monazite-sand industry in Travancore, India, including material on occurrence, mining, and preparation, has recently been released.[9]

Domestic industry is currently more interested in the rare earths contained in monazite than in the thorium content. Perhaps the largest use is for the rare-earth oxides and fluorides required in the cores of positive arc electrodes for moving-picture projectors and floodlights. Glass polishing with cerium oxide is also gaining in volume. The advantages claimed for this material are increased speed in the production of finished lenses, lack of stain on the hands and clothing—in contrast to rouge (ferric oxide), and a brighter polish on the finished product. Rare-earth chlorides are also utilized by the bleaching and dyeing industry.

In view of the difficulties in obtaining imported monazite, the consumers are making every effort to locate domestic deposits of commercial size. Market requirements are 8 percent thorium and 63 to 68 percent rare earth content. Current market prices for monazite containing 65 percent rare earths are $60 to $65 per short ton, f. o. b. Atlantic seaports.

OLIVINE

In 1946 shipments of olivine reached an all-time high of 7,649 short tons valued at $92,868. Most of the production was consumed in refractories, but one operator reported the use of his material as building stone, road ballast, and concrete sand.

Several other new uses for this mineral are in the laboratory and pilot-plant stage. Manganese Products, Inc., Seattle, Wash., has purchased a deposit of olivine on Cypress Island in the San Juan Archipelago for use in the production of fertilizer. The fusion of this mineral with phosphate rock produces a fertilizer containing about 20

[8] Copies may be purchased from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at 10 cents per copy.

[9] Viswanathan, P., Beach Minerals of Travancore: Science and Culture (Calcutta), vol. 12, No. 1, 1946, pp. 22–27.

Olivine sold or used by producers in the United States, 1942–46

Year	Short tons	Value	Year	Short tons	Value
1942	5,739	$45,201	1945	(1)	(1)
1943	5,415	48,633	1946	7,649	$92,868
1944	3,270	35,207			

[1] Data not available for publication.

percent available phosphate. Refractory blocks composed of olivine, magnesite, and sodium silicate as binder that stand up well at 1,500° C. have been prepared at the Bureau of Mines, Norris, Tenn., Station. A report which describes a method for the production of pure magnesium chloride from olivine has also recently been released by the Bureau of Mines.[10]

A rough estimate of the cost of the commercial production of MgO from this product was also included. The Minerals Research Laboratory, North Carolina State College, Asheville, N. C., is investigating the possibility of using olivine in the production of roofing granules.[11]

PERLITE

After several years of pilot-plant development, the perlite industry started commercial production in 1946, and the output reached 4,206 short tons. Five companies reported production: The Chem-Cote Perlite Corp., Superior, Ariz.; Superior Perlite Co., Superior, Ariz.; Rheem Research Products, Inc., 714 West Olympic Boulevard, Los Angeles, Calif., with operations also at Superior, Ariz.; Continental Basic Materials Corp., Chula Vista, Calif., with operation near Beatty, Nev.; and the Great Lakes Carbon Corp., 22 East 40th Street, New York, N. Y., with a quarry at Superior, Ariz., and processing plant at Torrance, Calif. Only three companies, however, made shipments, which totaled 3,022 tons. As one of these sold only processed material, value figures cannot be released. Dant & Russell, Inc., of Portland, Oreg., virtually completed pilot-plant work in 1946 on material from a perlite deposit in southern Wasco County, Oreg., and expect to get into commercial production in 1947.[12] Several other companies have completed pilot-plant tests and also expect to get into production in 1947.

All the material sold in 1946 was utilized by the construction industry as thermal insulation and lightweight aggregate.

A review of the available information on the physical properties, preparation, and uses of this material has recently been released by the Bureau of Mines.[13]

The average price of unprocessed perlite was $5.50 per short ton, f. o. b. mine; the processed material brought $35 to $37 per ton.

[10] Gee, E. A., McCarthy, C. E., Riordan, Frank S., Jr., and Pawel, Morton T., Magnesia From Olivine: Rept. of Investigations 3938, 1946, 33 pp.

[11] Murdock, T. G., Mineral Raw Materials for Roofing Manufacture: North Carolina Dept. of Conservation and Development, Resource Industry, Ser. 2, 1946, p. 14.

[12] Allen, J. E., Perlite Deposits Near the Deschutes River, Southern Wasco County, Oreg., G. M. 1 Short Paper No. 16, 1946, State Dept. of Geol. & Mineral Industries, Portland, Oreg.

[13] Ralston, O. C., Perlite, Source of Synthetic Pumice: Bureau of Mines Inf. Circ. 7364, 1946, 11 pages.

RADIO-GRADE QUARTZ

Imports of uncut quartz crystal reached 370,556 pounds valued at $2,376,598 in 1946, and 36 companies produced 1,744,100 finished piezoelectric devices.

Brazil remains virtually the sole supplier of radio-grade quartz, although small quantities were also received from Madagascar and Denmark. Previous shipments from Madagascar have been rejected because the material was poorly graded. The Quartz Society of Madagascar, however, has renewed its efforts to enter the market and has started a more rigid inspection of the material before shipping. It is believed that the 6,600 pounds of quartz valued at $78 received from Denmark is not of radio grade because the value reported is far below the price quoted for such material.

The accompanying table shows the quantity of quartz imported and the number of piezoelectric devices produced in recent years.

Imports of uncut quartz crystal, consumption of radio-grade quartz, and production of piezoelectric devices in the United States, 1942–46

Year	Imports of uncut quartz crystal [1]		Consumption of radio-grade quartz [2] (pounds)	Production of piezoelectric devices [2 3] (number)
	Pounds	Value		
1942	2,612,106	$8,987,108	682,000	6,888,000
1943	3,356,000	11,409,803	1,588,000	22,575,000
1944	2,300,506	11,178,643	1,858,000	29,939,000
1945	1,329,798	6,190,621	1,040,000	18,918,000
1946	370,556	2,376,598	172,400	1,744,100

[1] Includes optical-grade quartz used in production of optical instruments.
[2] 1942–44, War Production Board.
[3] Includes oscillators, resonators, and other piezoelectric devices.

The discovery of deposits of radio-grade quartz in Africa [14] and in the Karuli State of India [15] have recently been reported.

A survey of the efforts of the Germans to produce radio-grade quartz during World War II shows that their program yielded significant experimental results which show definite promise, but no crystals of commercial grade. They were not only hampered by a shortage of quartz, but also by lack of coordination and planning in the manufacture of piezoelectric devices. Trade secrets among individual companies were not shared, and fabrication techniques were neither modern nor efficient.

Rochelle salts, which have better piezoelectric qualities than quartz but are less stable, are being utilized in the United States as crystal filters and sonar projectors by the telephone, radio, and electronic industries. The Soviet press also reports the production of such crystals from sodium-potassium tartrate, a byproduct of the wine industry. These crystals, however, do not meet the specifications for radio-grade quartz and thus will not affect the stock-pile requirements of quartz crystals.

It is believed that the demand by industry and the armed forces for radio-grade quartz for the next few years will be largely for 100- to

[14] Temperley, B. N., Piezo-Electric Quartz Crystals: South African Min. and Eng. Jour., vol. 57, No. 2782, 1946, pp. 373–378.
[15] Dubiz, V. S., and others, A Deposit of Quartz Crystals near Saportra, Karuli State, India: Chem. Abs., vol. 40, No. 15, 1946, p. 4319.

500-gram material, the greatest demand being for plates of one-half square inch. Smaller quantities of material, weighing 1,000 grams and over, will also be required for uses of equal importance. The larger pieces will be utilized in the production of prisms for infrared work. Although annual requirements will not reach the wartime level, the many new military and commercial uses for piezoelectric devices will insure a steady demand for radio-grade quartz.

Buying prices for radio grade quartz in 1946 were essentially the same as in 1945, ranging from $1.50 per pound to $36.95 per pound according to quality. They were reported in detail in Minerals Yearbook, 1943, p. 1586.

STRONTIUM MINERALS

[By Charles L. Harness]

The year 1946 almost wrote "finis" to the domestic celestite industry. Founded in the late thirties as a substitute for barite in drilling oil wells, the industry received added impetus during the war years as a source of raw material for tracer bullets. These markets are gone. The patent on the use of barite in drilling wells expired in 1943, and with it the $17 per ton royalty which had permitted celestite to compete with barite. Purchases of domestic celestite for war needs virtually ceased in 1944. Only 243 tons of celestite valued at $3,726 were sold in 1946, by two firms in California, the Pan-Chemical Co., 205 First National Bank Building, Pomona—mine near Westmorland; and Rowe, Gabelic & Beuhler, 1555 Sunset Avenue, Pasadena 3—mine near Ludlow. These figures compare with 2,784 short tons valued at $27,840 in 1945, and 3,005 tons valued at $48,165 in 1944. Shipments in 1946 went mostly into strontium chemicals, with small quantities sold for oil-well drilling.

Peacetime uses of celestite are mainly red signal flares ("fusees") for railroads, trucks, aircraft, and ships. Minor uses are ceramic fluxes, medicinals, and lubricants. Strontium greases are said to be stable in the range of 300°–400° F., water- and hydrocarbon-resistant, and resistant to mechanical working.[16]

E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., and Foote Mineral Co., Philadelphia, Pa., are the two main buyers in the East. In the West Barium Products, Ltd., Modesto, Calif., is occasionally in the market.

In 1946 imported crude celestite was worth about $28 to $30 a short ton laid down at Philadelphia.

Celestite imported for consumption in the United States, 1944–46, by countries, in short tons

Country	1944		1945		1946	
	Short tons	Value	Short tons	Value	Short tons	Value
Mexico	3,170	$38,191	3,016	$38,365	1,977	$24,165
Spain	2,622	47,576	675	12,251		
United Kingdom	1	652			2,530	42,033
	5,793	86,419	3,691	50,616	4,507	66,198

[16] Worth, H. J., and McClennon, L. W., Strontium Greases: Oil and Gas Jour., vol. 45, No. 43, Mar. 1, 1947, pp. 74, 78.

Exports of strontium salts were not separately classified in 1946, and thus totals are not available. Exports for 1944 and 1945 are shown in the accompanying table, as they were incorrectly reported in the 1945 volume, the data for 1944 and 1945 being transposed.

Strontium chemicals exported from the United States, 1944–45 [1], in short tons

	1944		1945	
	Short tons	Value	Short tons	Value
Strontium nitrate	284	$52,129	223	$36,698
Strontium oxalate	19	15,058	2	1,198
Other	17	24,269	13	7,823
	320	91,456	238	45,719

[1] Not separately classified beginning January 1, 1946.

TOPAZ

Shipments of topaz in 1946 from the Brewer mine near Kershaw, S. C., were lower than in the previous year. The Carolina Mining & Exploration Corp., of Naples, N. C., was the only producer. Crude topaz crushed and screened or in lump form was used in the production of refractory cements and for thinning slag in open-hearth furnaces. At the Bureau of Mines Southern Experiment Station a very good refractory has been made from a mixture of topaz and domestic kyanite. Because of the fuming of the escaping fluoride, which requires great care in handling, refractory manufacturers are not using this material.

VERMICULITE

The upward trend in the production and sale of vermiculite which began in 1944 continued through 1946 and reached a new high of 86,390 short tons, 33 percent above the previous record set in 1945. Exfoliated vermiculite was used in 1946 principally in lightweight aggregate for concrete and in plaster.

Production in 1946 was reported from seven States: Colorado, Montana, Nevada, North Carolina, South Carolina, Texas, and Wyoming. As in previous years, the bulk of the output came from the Universal Zonolite Insulation Co. mine at Libby, Mont. This company also produced cleaned and screened vermiculite from a deposit near Traveller's Rest, S. C., in 1946. The property has been under lease for some time, but this represents the first commercial production by Universal Zonolite in the East.

The AleXite Engineering Co., of Colorado Springs, Colo., has opened a new deposit in the Encampment district of Wyoming, which is reported to be the second largest in the United States.

The Southwestern Graphite Co., at Burnet, Tex., is a new producer of vermiculite and first reported output in 1946. Barrimore & Sons, of Hollywood, Calif., has purchased a vermiculite deposit near Silver Peak, Nev., and expects to get into commercial production in 1947.

Vermiculite was released from price control on July 26, 1946, under Amendment 36, Office of Price Administration Supplementary Order 129. However, as this mineral was in good supply, prices were not

affected. Screened and cleaned vermiculite averages $8 to $12 per short ton. Recent information obtained from exfoliators places the loss of weight in exfoliating at about 5 percent. Assuming an average price of $75 per ton, the total value of exfoliated vermiculite sold in 1946 would be approximately $6,155,000.

Some relatively new uses for exfoliated vermiculite are in insulating refractory brick, lightweight and fireproof structural units, and non-load-bearing partition tile.[17] United States Patent 2,411,470 was granted to Thomas Patton Gladstone Shaw of Shawinigan Falls, Quebec, Canada, in November 1946. This patent covers invention of a product composed of vermiculite and a thermoplastic resin which may be used as floor covering, gasket, crown-cap seals, and insulation. Shaw has assigned the patent to Shawinigan Chemicals, Ltd., Montreal, Quebec. A review of the occurrence and utilization of the vermiculites has recently been released by the Colorado School of Mines, at Golden.[18] The tonnage and value of screened and cleaned vermiculite shipped in recent years are shown in the accompanying table.

Screened and cleaned vermiculite sold or used by producers in the United States, 1935–39 (average) and 1940–46

Year	Short tons	Value	Year	Short tons	Value
1935–39 (average)	18,486	$180,297	1943	46,645	$471,595
1940	22,299	137,698	1944	54,116	541,744
1941	23,438	125,444	1945	64,808	648,077
1942	57,848	319,931	1946	86,390	867,973

WOLLASTONITE

Production and sales of wollastonite from the Burnham property near Willsboro, N. Y., were lower in 1946 than as reported in 1945.

The Industrial Research Division of the United States Department of Commerce is sponsoring a research program to determine the value of this mineral in the manufacture of thermal insulation, in glaze for pottery, and as a filler in paint, rubber, and linoleum.

[17] Rea, F. R., Vermiculite Added to Fired Clay Products Offers New Uses: Brick and Clay Rec., vol. 108, 1946, No. 3, pp. 54 and 58, and No. 5, p. 68.

[18] Goldstein, A., The Vermiculites and Their Utilization: Colorado Sch. Mines Quart., vol. 41, No. 4, 1946, 64 pp.

PART III. STATE REVIEWS

The Mineral Industry of Alaska

(MINE REPORT)

By ALFRED L. RANSOME [1]

GENERAL SUMMARY

PARTIAL restoration of gold mining, an all-time record in coal output, and a fairly steady yield of crude platinum were chiefly responsible for raising the value of mineral production in Alaska to $12,430,000 in 1946 from $10,174,000 in 1945. However, the value in 1946 was lower than in any of the 40 preceding years except 1931–32 and 1943–45 and was less than half of any year in the 1937–41 period. Gold regained in 1946 its leadership as the mineral produced in greatest value, followed by coal, platinum, sand and gravel, mercury, silver, tungsten, and lead. A general report on Alaska's mineral resources was published [2] by the Bureau of Mines.

Mineral production of Alaska, 1944–46

	1944		1945		1946	
	Quantity	Value	Quantity	Value	Quantity	Value
Antimony ore.....short tons	73	$6,465				
Asbestos (shipments).....do	(1)	(1)				
Chromite (shipments).....do	1,845	64,456				
Coal, bituminous, and lignite.....do	348,375	2,239,684	297,644	$1,868,592	368,000	$2,359,000
Copper.....do	2	540	5	1,350	2	648
Gold.....troy ounces	49,296	1,725,360	68,117	2,384,095	226,781	7,937,335
Lead.....short tons	44	7,040	11	1,892	115	25,070
Mercury.....flasks (76 pounds)	(1)	(1)	(1)	(1)	699	68,670
Platinum metals (crude).....troy ounces	33,616	(1)	26,505	(1)	22,882	(1)
Sand and gravel.....short tons	712,496	499,269	(1)	(1)	(1)	(1)
Silver.....troy ounces	13,362	9,502	9,983	7,099	41,793	33,769
Tungsten (60-percent concentrates) [2] short tons	19	(1)			19	(1)
Miscellaneous [3]		2,350,309		5,910,704		2,005,241
Total		6,903,000		10,174,000		12,430,000

[1] Bureau of Mines not at liberty to publish separately; value included with "Miscellaneous."
[2] Shipments.
[3] Comprises value of stone and value of items indicated by "(1)".

Production of gold in Alaska in 1946 more than tripled the output in 1945, but the 226,781 fine ounces valued at $7,937,335 recovered from ores and gravels was still far short of output during the years immediately preceding the war. The value of the gold in 1946 was 99 percent of the total value of the gold, silver, copper, and lead

[1] Statements on minerals other than gold, silver, copper, lead, and zinc were prepared by other members of Bureau of Mines.
[2] Bain, H. Foster, Alaska's Minerals As a Basis for Industry: Bureau of Mines Inf. Cir. 7379, 1946, 88 pp.

produced. As the 1946 season was the first full one since War Production Board Limitation Order L-208 was rescinded July 1, 1945, gold production might have been expected to be much higher. The fact that it was not greater was due apparently to the continuing difficulty in obtaining and transporting mining equipment and supplies, to cost of such equipment and supplies, and to labor costs so high that there was but little incentive to work gold properties. The shipping strike on the Pacific coast late in 1946 had little effect on mining during the year but did result in delaying shipments of concentrates and bullion to smelters and refineries in the United States and of supplies to Alaska.

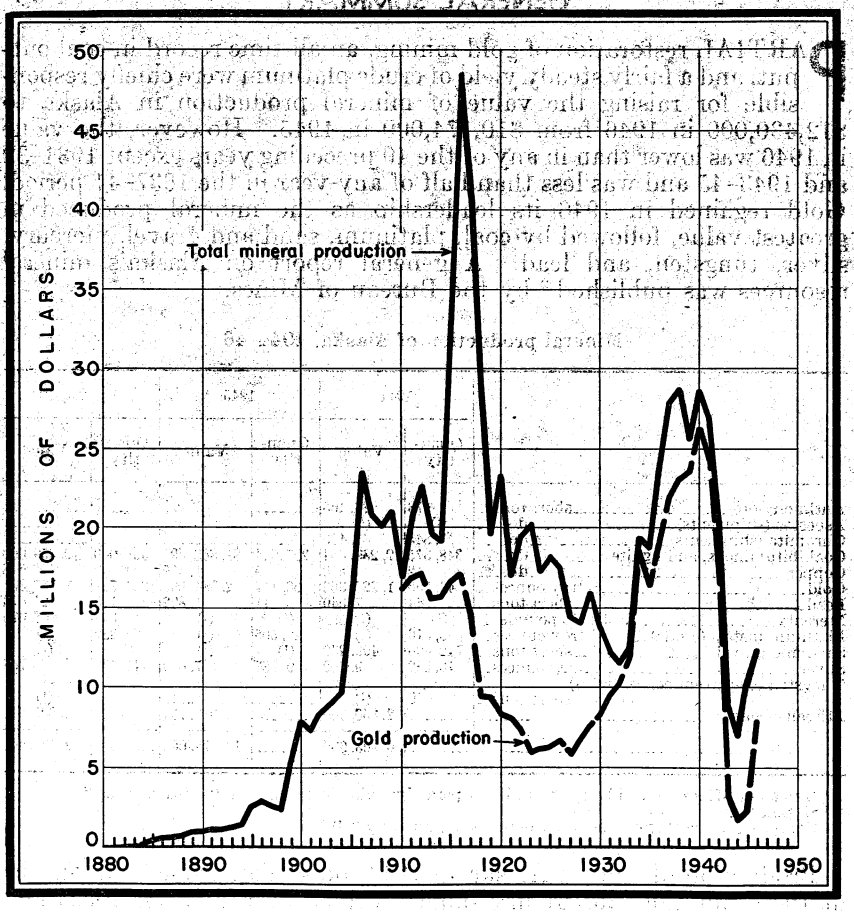

FIGURE 1.—Trends in value of total mineral production (1880–1946) and gold production (1910–46) in Alaska. From 1911 to 1931 copper production accounted for most of the value of minerals other than gold.

Production from placer operations provided much of the increased gold output, largely because the dredging companies were in a better position than the lode-mine operators to resume work. In all, 24 dredges and 38 draglines operated during the year, as compared with

14 (revised) and 16, respectively, in 1945. In addition, 244 other placer properties were active some portion of the year (172 in 1945). Of the lode mines, production was reported from 16 properties, 2 less than in 1945.

PRODUCTION OF GOLD, SILVER, COPPER, AND LEAD

The accompanying tables show the mine production of gold, silver, copper, and lead in Alaska, 1942–46, and 1880–1946, in terms of recovered metals; the output of gold and silver in 1946, by types of operation; and the output of gold, silver, copper, and lead, from amalgamation and cyanidation mills (with or without concentration equipment) in 1946, by regions.

A small proportion of the production shown in the tables following was mined in the years 1942–45 but apparently was not then shipped because of war or other conditions. Shipments of 41,211 ounces of gold and 6,339 ounces of silver received at the Seattle Assay Office in January and February 1947 are here credited as 1946 production. The greater part of these shipments no doubt would have been received at the Seattle Assay Office in 1946 had there been no shipping strike.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

Yardage figures used in measuring material treated in placer operations are "bank measure"; that is, the material is measured in the ground before treatment.

The value of gold, silver, copper, and lead production herein reported has been calculated at the following prices:

Prices of gold, silver, copper, and lead, 1942–46

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*
1942	$35.00	$0.711+	$0.121	$0.067
1943	35.00	.711+	.130	.075
1944	35.00	.711+	.135	.080
1945	35.00	.711+	.135	.086
1946	35.00	.808	.162	.109

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] Treasury buying price for newly mined silver. 1942 to June 30, 1946: $0.71111111; July 1 to Dec. 31, 1946: $0.905.
[3] Yearly average weighted price of all grades of primary metal sold by producers; price includes bonus payments by Office of Metals Reserve for overquota production.

Gold.—Floating connected-bucket dredges recovered 65 percent of the total Alaska output of gold in 1946 compared with 51 percent in 1945; 24 dredges operated during the year at 18 properties. Three mines operated two dredges each and one mine operated four dredges. In all, placer and lode mines in 1946 yielded (in terms of recoverable metal) 226,781 ounces of gold valued at $7,937,335 compared with 68,117 ounces valued at $2,384,095 in 1945, an increase of 233 percent. This apparently marked improvement is less impressive when 1946 output is compared with that in 1940 (755,970 ounces, valued at $26,458,950). The United States Smelting Refining & Mining Co.,

operating four connected-bucket dredges in the Fairbanks district, Yukon River Basin region, was the largest producer of gold in Alaska in 1946. The following nine companies (all operating placer mines) were important producers in the order listed: New York Alaska Gold Dredging Corp. (two connected-bucket dredges, Tuluksak River), Tuluksak-Aniak district, Kuskokwim region; Arctic Circle Exploration Co. (connected-bucket dredge and hydraulic giants, Candle Creek), Fairhaven district, Seward Peninsula region; Alluvial Golds, Inc. (connected-bucket dredge, Woodchopper Creek), Circle district, Yukon River Basin region; Cripple Creek Mining Co. (dragline operation, Cripple Creek), Innoko district, Yukon River Basin region; Brinker-Johnson Co. (connected-bucket dredge, Caribou Creek), Fairbanks district, Yukon River Basin region; Gold Placers, Inc. (connected-bucket dredge, Coal Creek), Circle district, Yukon River Basin region; Yukon Placer Mining Co. (Walker's Fork Creek), Fortymile district, Yukon River Basin region; Nome Creek Mining Co. (connected-bucket dredge, Nome Creek), Toloyana district, Yukon River Basin region; and Wade Creek Dredging Co. (Jack Wade Creek), Fortymile district, Yukon River Basin region. Of the lode mines active during 1946, the Cleary Hill Mines Co., Cleary Hill mine (Fairbanks district), and the Alaska Pacific Consolidated Mining Co., Independence mine (Willow Creek district, Cook Inlet-Susitna region), were the most important. A substantial quantity of gold came from clean-up operations at the Alaska-Juneau mill, but the mine did not operate during 1946. Only 3 percent of the total Alaska output of gold in 1946 came from lode mines.

Silver.—Of the silver produced in Alaska in 1946, 83 percent was a byproduct of gold mining, and 17 percent came from lead ore. The ratio of silver production to gold production in 1946 was 1 : 5.4, compared with 1 : 6.8 in 1945. The most important producer of silver in Alaska in 1946 was the United States Smelting Refining & Mining Co.; the silver was a byproduct of connected-bucket gold-dredging operations in the Fairbanks district.

Copper and lead.—The Southeastern Alaska region was the sole source of copper and lead production in 1946. Both metals were recovered from lead concentrate shipped to United States smelters outside the Territory for treatment.

Mine production of gold, silver, copper, and lead in Alaska, 1942–46, and total 1880–1946, in terms of recovered metals

Year	Gold (lode and placer)		Silver (lode and placer)		Copper		Lead		Total value
	Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	
1942	487,621	$17,066,735	119,704	$85,123	44,000	$5,324	830,000	$55,610	$17,212,792
1943	99,583	3,485,405	42,788	30,427	54,000	7,020	400,000	30,000	3,552,852
1944	49,296	1,725,360	13,362	9,502	4,000	540	88,000	7,040	1,742,442
1945	68,117	2,384,095	9,983	7,099	10,000	1,350	22,000	1,892	2,394,436
1946	226,781	7,937,335	41,793	33,769	4,000	648	230,000	25,070	7,996,822
1880–1946	26,083,428	625,934,582	19,790,298	14,081,591	[1]685,866	226,563,864	[1] 24,926	2,774,633	869,354,670

[1] Short tons.

Mine production of gold and silver in Alaska in 1946, by types of operation in terms of recovered metals

Type of operation	Mines producing	Material treated	Gold			Silver			Total value
			Fine ounces	Percent of total		Fine ounces	Percent of total		
				1946	1945		1946	1945	
Lode mines	16	[1] 10,798	6,073	3	15	8,137	19	29	$219,130
Floating connected-bucket dredges	[2] 18	[3] 9,789,300	148,834	65	51	21,752	52	39	5,226,766
Other placers (dragline and dry-land dredges, hydraulic, drift mining, etc.)	[4] 282	([5])	71,874	32	34	11,904	29	32	2,525,208
Total: 1946	316		226,781	100		41,793	100		7,971,104
1945	218		68,117		100	9,983		100	2,391,194

[1] Short tons of ore.
[2] 24 dredges; 3 mines operated 2 dredges each, and 1 mine operated 4 dredges.
[3] Cubic yards of gravel.
[4] Includes all other types and sizes of placer operations.
[5] Figure not available.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Alaska in 1946, by regions, in terms of recovered metals

Region	Ore treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal			
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Lead (pounds)
Cook Inlet-Susitna	2,698	1,006	57	55	269	22	
Copper River	500	282	36				
Kenai Peninsula	399	175	48	3	16	8	
Kuskokwim	375	561	169				
Southeastern Alaska	3,172	1,819	295	3	27	51	
Yukon River Basin	1,295	1,676	351				
Total: 1946	8,439	5,519	956	61	312	81	
1945	6,506	9,214	1,660	104	1,192	1,199	22,000

Bullion of Alaska origin deposited at United States Assay Office, Seattle, Wash., during 1946, in fine ounces

Region	Gold	Silver	Region	Gold	Silver
Cook Inlet-Susitna	1,944	223	Seward Peninsula	22,720	2,827
Copper River	626	69	Southeastern Alaska	1,847	298
Kenai Peninsula	125	31	Yukon River Basin	143,037	22,855
Kodiak Island	7	1			
Kuskokwim	14,468	1,582		184,774	27,886

COOK INLET-SUSITNA REGION

Willow Creek District.—The Alaska-Pacific Consolidated Mining Co. operated its Independence mine on the west fork of Fishhook Creek north of Wasilla from May 10 to December 31, 1946. The 70-ton amalgamation-flotation-concentration mill operated only from November 5 to December 22, treating 2,138 tons of gold ore;

774 ounces of gold and 45 ounces of silver were recovered by amalgamation and 269 ounces of gold and a few ounces of silver from 55 tons of concentrates produced. The Gold Cord Mining Co. operated the Gold Cord mine on Fishhook Creek north of Wasilla during the latter half of 1946, treating gold ore by amalgamation. No placer mines reported production in the district in 1946.

Yentna-Cache Creek District.—Placer mines (24 mines), including several hydraulic operations, yielded considerable gold from stream and bench gravels. Among the larger producers were the Morgan & Kellogg Mining Co. and Collinsville Mines (dragline-dredge operation).

COPPER RIVER REGION

Chistochina District.—Of the four placer mines that operated during 1946, the Slate Creek Gold Placers property was the most important; 668 ounces of gold and 62 ounces of silver were recovered by hydraulicking 19,000 cubic yards of bench and creek-bed gravels.

Nizina District.—Only three placer mines were worked during 1946, the principal one being operated by the Chitutu Mines.

Prince William Sound District.—The Young-Garner Mining Co. operated the Granite lode gold mine 2 miles north of Hobo Bay from April 6 to September 7, 1946.

KENAI PENINSULA REGION

Moose Pass-Hope District.—The Chugach Mining Co. operated a placer mine on Resurrection Creek, but the greater production of gold from the district came from two lode mines—the Marigold operated by George Lindsey and the Skeen-Leckner (Falls Creek) mine by the Falls Creek Mining Co.

KUSKOKWIM REGION

Goodnews Bay District.—The largest producer of gold in the district was the Bristol Bay Mining Co. operating No. 2 claim above Wata-muse Creek; 2,713 ounces of gold and 657 ounces of silver were recovered from 65,212 cubic yards of stream gravel using a dragline excavator and floating washing plant. The Goodnews Bay Mining Co. operated a Diesel-electric connected-bucket dredge (equipped with 93 8-cubic-foot buckets) and two 1¼-cubic-yard Diesel-powered dragline excavators on its property on the Salmon River for the recovery of platinum during 1946; gold was recovered as a byproduct.

McGrath District.—Strandberg & Sons, using dragline equipment on Candle Creek, was the only placer-mine operator in the district. The only producing lode mine was the Nixon Fork owned by Mespelt & Co. and operated from August 8 to December 31 by the Nixon Fork Mining Co. under a purchase contract; 375 tons of gold ore were milled in a 50-ton stamp mill and 561 ounces of gold and 169 of silver recovered by amalgamation.

Tuluksak-Aniak District.—Two floating connected-bucket dredges were operated by the New York Alaska Gold Dredging Corp., the largest gold producer in the region and the second largest in the Territory in 1946. Other important producers using dragline equipment at placer properties were Peandori Placer Mining Co. (on Cripple

and Dome Creeks) and Marvel Creek Mining Co. (on Marvel Creek); the last-named company recovered 1,746 ounces of gold and 246 ounces of silver from 100,000 cubic yards of gravel washed.

NORTHWESTERN ALASKA REGION

Kiana District.—Mining in the Northwestern Alaska region—comprising the Kiana and Shungnak districts and covering the area of the Kobuk River Valley—was confined to four placer operations during 1946, two in each district. The Lammers Exploration Co. recovered a sizable quantity of gold from its operation of a floating Diesel-electric connected-bucket dredge (equipped with 57 3-cubic-foot buckets) on Klery Creek, Kiana district, from August 14 through October 1, 1946.

SEWARD PENINSULA REGION

The Seward Peninsula region had seven floating connected-bucket dredges in 1946; in addition, there were numerous bulldozer-hydraulicking, dragline, and ground-sluicing operations, but no producing lode mines.

Council-Bluff District.—The principal producers in the district were Swanberg & Sons on Niukluk River, Sourdough Dredging Co. on Ophir Creek, and L. E. Ost on Ophir and Crooked Creeks.

Fairhaven District.—The Arctic Circle Exploration Co., operating two dredges (each with 70 3½-cubic-yard buckets) on Candle Creek, ranked first in production of gold in the district and in the region and third in the Territory; a substantial quantity of gold was recovered, in addition, by hydraulic operations, also on Candle Creek. Other companies operating connected-bucket dredges in the district were Dry Creek Dredging Co. and the Forsgren Dredging Co., both operating on the Inmachuk River. Among other larger producers of gold from placers worked hydraulically and in combination with bulldozers, draglines, and pumping equipment were John B. Havenstrite and Northern States Mines Co.

Kougarok District.—Mining in the district was limited in 1946 to placer operations, principally by hydraulicking and ground sluicing methods; the larger operators were the Grant Mining Co. on Coffee Creek, Dahl Creek Mining Co. on Dahl Creek, Louis Nashenweng on Quartz Creek, Rainbow Mines, and the Trinity Mining Co. on the Kougarok River.

Koyuk District.—Of the five placer mines working during 1946, the Wallace Porter operation on Bear and Sweepstake Creeks was the largest.

Nome District.—The largest gold producer in the district was the Lee Bros. Dredging Co., operating two floating connected-bucket dredges on the Solomon River and Little Hurrah Creek. Casa de Paga Gold Co., operated a floating connected-bucket dredge (equipped with 66 2-cubic-foot buckets) near Nome; 1,628 ounces of gold and 203 of silver were recovered from 169,000 cubic yards of gravel handled during the 1946 season. Tolbert Scott operated a connected-bucket dredge on Iron Creek.

Among the larger producers of gold from placers worked by hydraulic giants with some combination of bulldozers, draglines, and pumping equipment were: Peter Curran on Big Hurrah Creek,

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Glacier Creek Mining Co. working the Rainbow claim on Glacier Creek, E. W. Quigley, and Herbert Engstrom on Clara and Basin Creeks. A number of small-scale hand operators recovered some gold from beach sands on Nome beach.

Port Clarence District.—Of the 10 placer mines worked in the district during the 1946 season, the largest operation was carried on by N. B. Tweet & Sons on Igloo Creek from June 15 to September 15; gold was recovered from stream gravel, using a bulldozer, hydraulic giant, and pumping plant.

Serpentine River District.—George Bodis operated a hydraulic mine on Dick Creek from June 20 to September 20.

SOUTHEASTERN ALASKA REGION

A third of the total Alaska lode gold output in 1946 came from five mines in the Hyder, Juneau, and Ketchikan districts, Southeastern Alaska; no placer operations were reported active. All of the copper and lead came from this region.

Hyder District.—The J. H. Scott Co. operated the Riverside Tungsten & Lead mine from April 25 to November 14, 1946, treating lead ore in its 50-ton combination flotation-gravity concentration mill.

Juneau District.—The Alaska Juneau mine did not operate during 1946, but the greater proportion of the gold from the district came from clean-up of the Alaska Juneau mill.

Ketchikan District.—The Hope Puyallup mine was operated from July 1 to August 20 by Adams and Brill; gold ore was treated by amalgamation. Wendell Dawson shipped gold concentrates to a smelter from the Dawson mine in 1946 and also recovered gold by amalgamation.

YUKON RIVER BASIN REGION

The Yukon River Basin region accounted for 79 percent of the total Alaska gold in 1946 from 156 placer and 5 lode mines in 16 districts, including the Bonnifield-Nenana, Chandalar, Chisana, Circle, Eagle, Fairbanks, Fortymile, Hot Springs, Iditarod, Innoko, Kantishna, Koyukuk, Marshall, Rampart, Ruby, and Tolovana. Of the 176,606 ounces of placer gold produced in the region, 71 percent was recovered by eight floating connected-bucket dredges. Nearly one-third of the total Alaska gold from lode mines came from the region. The Fairbanks district was the most important.

Chisana District.—After being idle for nearly 5 years during the war, work was resumed at the Golden Eagle property (Nabesna mine) of the Nabesna Mining Corp. on June 1, 1946. Actual operation was limited to September; the 100-ton concentration mill was operated 255 hours and treated 540 tons of gold ore by gravity method. The 9 tons of concentrate produced were shipped to a smelter; 172 ounces of gold and 104 ounces of silver were recovered.

Circle District.—In the Circle district three dredges were active in 1946. Alluvial Golds, Inc., operated its Diesel-powered connected-bucket dredge (equipped with 72 4-cubic-foot buckets) on Woodchopper Creek. On Coal Creek, Gold Placers, Inc., ran a dredge of similar type equipped with 60 4-cubic-foot buckets. The C. J. Berry Dredging Co. operated a dredge on Lower Mammoth Creek. The out-

put by these dredges accounted for 82 percent of the gold from the district and placed the district in second place in gold produced in the Yukon River Basin region. Among the larger producers in the district using hydraulic giants and bulldozers or draglines with screening and washing plants were: Half Dollar Mining Co., Deadwood Mining Co., Harrison Creek Mining Co., and Frasca & Gibson.

Fairbanks District.—The United States Smelting, Refining & Mining Co., operating four floating connected-bucket dredges in the Fairbanks district, was by far the largest producer of gold and silver, not only in the district but in the Territory. The company operated 2 6-cubic-foot Bethlehem dredges (with 68 and 78 buckets, respectively), 1 10-cubic-foot Bethlehem dredge (with 113 buckets), and 1 10-cubic-foot Yuba dredge (with 106 buckets); all the dredges are electrically operated. Other equipment used (chiefly for removing overburden) included 45 Joshua Hendy hydraulic giants. Of the dredges operated in 1946, one each was on Cleary, Cripple, Ester, and Goldstream Creeks. Stripping operations were carried on at the Sheep Creek property of the company, but no actual mining.

The Brinker-Johnson Co. operated its W. W. Johnson Co. Diesel-powered connected-bucket dredge (with 78 4½-cubic-foot buckets) on Caribou Creek, 60 miles east of Fairbanks, from June 9 to November 1, 1946. The company, second largest producer in the district (and the only other dredge operator), recovered 3,914 ounces of gold and 460 ounces of silver from 476,600 cubic yards of gravel handled.

The Alder Creek Mining Co., the third largest producer in the Fairbanks district, handled approximately 372,000 cubic yards of gravel and overburden with hydraulic giants, bulldozer, and a 1½-cubic-yard dragline on Fairbanks Creek, May through September 1946; the yield was 1,887 ounces of gold and 274 ounces of silver. Other sizable producers in the district using hydraulic giants, bulldozers, and dragline equipment in various combinations were the Wolf Creek Mining Co., Parker, Raymond & Hopkins on Fairbanks and Ester Creeks, the Deep Creek Mining Co., Fish Creek Mining Co., and the Strom Co. on Rose Creek.

The Cleary Hill Mines Co., operating the Cleary Hill mine and amalgamation-flotation mill 27 miles northeast of Fairbanks, was the leading producer of lode gold in the district, which produced a total of 1,676 ounces of lode gold and 351 ounces of silver. Other small lode-gold producers in the Fairbanks district in 1946 included O. M. Grant (Irishman No. 1 mine), D. E. Turnbarge (Emma Creek mine), and A. J. Stern (St. Paul mine).

Fortymile District.—Of the placer gold recovered at 19 mines in the district during 1946, 83 percent came from properties operated by the Yukon Placer Mining Co. on Walker's Fork Creek and by the Wade Creek Dredging Co. on Jack Wade Creek. The Yukon Placer Mining Co. washed 235,000 cubic yards of gravel to recover 3,156 ounces of gold and 474 ounces of silver, and the Wade Creek Dredging Co. recovered 2,901 ounces of gold and 469 ounces of silver from 120,000 cubic yards of gravel.

Hot Springs District.—Among the larger operators in the Hot Springs district in 1946 were the Cleary Hill Mines Co., operating a dragline, hydraulic giants, and bulldozers on Tofty Creek, and Johnson & Johnson Co., hydraulicking on Glenn Gulch and Eureka Creek.

Iditarod District.—The North American Dredging Co., operating a connected-bucket dredge (with 70 3½-cubic-foot buckets) on Flat and Otter Creeks from June 10 to September 5, was the largest gold producer in the Iditarod district in 1946. The Awe Mining Co., Hatton, Banquier & Turner, Patrick Savage, Peter Miscovitch, and the Moore Creek Mining Co. were the larger producers of gold, using hydraulic giants, bulldozers, and dragline equipment in various combinations.

Innoko District.—Isaacson & Peterson operated its connected-bucket dredge on Ganes Creek during 1946. The largest producer of gold in the district was the Cripple Creek Mining Co., operating a dragline and portable dry-land washing plant on Cripple Creek. Degnan & Rosander operated similar equipment on Little Creek. Hubbard & McFarland operated Nos. 1, 2, and 3 claims on Helena Gulch, leased from Robert Jaquemai; 1,119 ounces of gold and 201 ounces of silver were recovered from 60,000 cubic yards of gravel sluiced through bedrock boxes using a dragline and two bulldozers. Hard & Uotila ground-sluiced 24,000 cubic yards of gold-bearing stream and bench gravel on Beaver and Bear Creeks, using a dragline and two bulldozers in conjunction with hydraulic giants; 953 ounces of gold and 95 ounces of silver were recovered. On lower Ophir Creek Uotila & Hard, using similar equipment, recovered 939 ounces of gold and 90 ounces of silver. Also using similar equipment, Savage & Matheson washed 90,000 cubic yards of bench gravel on Spruce Creek, recovering 871 ounces of gold and 110 ounces of silver, and N. J. Vibe operated on Little Creek recovering 858 ounces of gold and 173 of silver.

Kantishna District.—On Caribou Creek, Caribou Mines handled 145,340 cubic yards of gravel from June 6 to September 23, using a 1¼-cubic-yard dragline, two bulldozers, and a dry-land washing plant; 2,327 ounces of gold and 1,103 of silver were recovered.

Koyukuk District.—The principal producer of gold in the Koyukuk district in 1946 was the South Fork Mining Co., operating a dragline-bulldozer combination.

Marshall District.—The Yukon Mining Co. mined from April 1 to November 1 on placer ground on Bobtail, Windy, and Buster Creeks; sluicing was done on bedrock, using dragline, bulldozer, and pump equipment.

Rampart District.—There was little activity in the Rampart district during the 1946 season. The Little Minook Mining Co. operated from May 1 to September 25 on Little Minook Creek 10 miles southeast of Rampart, recovering 575 ounces of gold and 73 of silver from 25,000 yards of gold-bearing gravel washed. Equipment used included a dragline, two bulldozers, and four hydraulic giants.

Ruby District.—The Greenstone Mining Co. washed 100,000 cubic yards of bench gravel on Greenstone Creek from June 10 to November 7, recovering 895 ounces of gold and 134 of silver; equipment included two bulldozers and a hydraulic giant. Other large producers in the district among this type of placer operation were the Iver Johnson & Co., Peter Miscovitch & Sons, and the Long Creek Mining Co.

Tolovana District.—The Nome Creek Mining Co., the largest producer in the Tolovana district, operated its connected-bucket dredge (with 4-cubic-foot buckets) on Nome Creek from May 16 to

October 28; 3,097 ounces of gold and 238 of silver were recovered from 467,000 cubic yards of gravel. Parker & Son conducted placer operations on Olive Creek, and the Amy Creek Mining Co. operated on Amy Creek, using dragline-bulldozer-hydraulic giant equipment.

PRODUCTION OF OTHER MINERALS

Coal.—Production of bituminous coal and lignite in Alaska reached a new high in 1946 of 368,000 short tons valued at $2,359,000, a quantity 24 percent greater than in 1945 and 6 percent more than in the previous record year 1944. Output came principally from the lower Matanuska Valley field, 45 miles northeast of Anchorage, and the Nenana field, approximately 75 miles southwest of Fairbanks. A report[3] describing the properties of Alaska coals, location of coal fields, reserves, production, and distribution was published.

Gem Stones.—Jade (nephrite) of various grades is mined in the Kobuk River region. The Arctic Circle Exploration Co., principal producer and fabricator, shipped 13¾ short tons in the summer of 1946. Some of the material in the rough (according to Sydney H. Ball in the Gem Stones chapter of this volume) is worth $5 a pound, and select material is said to have brought $55 a pound.

Mercury.—In 1946, 699 flasks (76 pounds each) of mercury valued at $68,670 were produced by the Red Devil (New Idria-Alaska) and Decoursey Mountain mines, the former in a Gould rotary furnace and the latter in retorts. Developed reserves at the Red Devil were virtually worked out at the end of 1946, and further operations at the mine were reported to depend on higher prices.

Platinum Metals.—Placer deposits in the Goodnews Bay district in Southwestern Alaska yielded 22,882 ounces of crude platinum metals in 1946 (26,505 ounces in 1945). The platinum operations of the Goodnews Bay Mining Co. were described.[4]

Sand and Gravel.—Production of sand and gravel was 712,496 short tons ($499,269) in 1944. The output was greater in 1945 and 1946, but data are not available for publication.

Tungsten.—Shipments of tungsten concentrates in Alaska were 19 short tons (60 percent WO_3 equivalent) in 1946 compared with none in 1945 and 19 tons in 1944. Production of concentrates was 28 tons averaging 57 percent WO_3 in 1946; this output includes 15 tons of concentrate averaging 74.16 percent WO_3 recovered at Salt Lake City, Utah, from treating secondary concentrates produced in 1944. J. H. Scott, operating the Riverside mine near Hyder, produced (but did not ship) 13 tons of concentrate averaging 31.9 percent WO_3 in 1946. In the course of exploration work at the Big Chief mine near Fairbanks, the Yukon Corp. produced a few hundred pounds of concentrate averaging 63.4 percent WO_3 in 1946.

Miscellaneous Minerals.—Data on production of stone are not available for publication. There was no recorded production of antimony, asbestos, chromite, gypsum, iron ore, petroleum, tin, or zinc in Alaska in 1946.

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[3] Cooper, H. M., and others, Analyses of Alaska Coals: Bureau of Mines Tech. Paper 682, 1946, 114 pp.
[4] Mining World, Platinum Dredging: Vol. 8, No. 7, June 1946, pp. 26–29.

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Arizona

Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By C. E. NEEDHAM AND PAUL LUFF

	PAGE		PAGE
General summary	1311	Mining industry	1316
Calculation of value of metal production	1312	Ore classification	1317
Mine production by counties	1316	Metallurgic industry	1318
		Review by counties and districts	1321

GENERAL SUMMARY

DESPITE a serious labor strike at certain copper mines and smelters in Arizona from March 20 to June 30, the State copper production was approximately 1 percent greater in 1946 than in 1945. The upward trend in copper output to an average of 58,000,000 pounds a month during the last quarter of 1946 from an average of 48,000,000 pounds a month during the first quarter more than offset a pending decrease. The outputs of gold, lead, and zinc increased also, but that of silver declined; however, the value of the silver output was greater, owing to an increase in the average market price of the metal. Production in 1946 (in terms of recoverable metals) was 79,024 fine ounces of gold, 3,268,765 fine ounces of silver, 578,446,000 pounds of copper, 47,860,000 pounds of lead, and 87,330,000 pounds of zinc, indicating increases over 1945 of 2 percent in gold, nearly 1 percent in copper, 5 percent in lead, and 9 percent in zinc; the output of silver decreased 8 percent. The total value of the five metals was $114,986,254 in 1946, the greatest value since 1943 and a 20-percent gain over 1945. The total value of the gold was $2,765,840—2 percent of the State total value; silver, $2,641,162—2 percent; copper, $93,708,252—more than 81 percent; lead, $5,216,740—more than 4 percent; and zinc, $10,654,260—9 percent. The value of the metals recovered from copper ore was $96,309,170 in 1946 ($80,461,465 in 1945), or 84 percent of the State total. About 89 percent of the State gold production and 78 percent of the silver in 1946 came from seven districts—Ajo, Big Bug, Copper Mountain (Morenci), Globe-Miami, Pioneer (Superior), Verde (Jerome), and Warren (Bisbee); 98 percent of the copper came from eight districts—Ajo, Copper Mountain (Morenci), Eureka (Bagdad), Globe-Miami, Mineral Creek (Ray), Pioneer (Superior), Verde (Jerome), and Warren (Bisbee); 84 percent of the lead came from four districts—Big Bug, Old Hat, Pima, and Warren (Bisbee); and 91 percent of the zinc came from six districts—Big Bug, Cochise (Dragoon), Harshaw. Old Hat, Pima, and Warren (Bisbee).

Of outstanding significance to the copper industry was the con-

tinued development of the San Manuel property in Pinal County, which has proved to date a total of 211,500,000 tons of copper ore. The ore body is one of the relatively small number of really large copper deposits discovered in the United States and the only one in many years.

The base price of copper, lead, and zinc rose in 1946, the first time since February 1942, when the Government inaugurated the Premium Price Plan. The average price of copper increased to $0.162 a pound in 1946; lead to $0.109 a pound; and zinc to $0.122 a pound. The price of gold remained at $35 per fine ounce, but the average price of silver rose to $0.808 per fine ounce. The basic Government policy of premium payments for overquota production of copper, lead, and zinc remained in force throughout 1946.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices:

Prices of gold, silver, copper, lead, and zinc, 1942–46

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1942	$35.00	$0.711+	$0.121	$0.067	$0.093
1943	35.00	.711+	.130	.075	.108
1944	35.00	.711+	.135	.080	.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] Treasury buying price for newly mined silver. 1942 to June 30, 1946: $0.71111111; July 1, 1946 to Dec. 31, 1946: $0.905.
[3] Yearly average weighted price of all grades of primary metal sold by producers; price includes bonus payments by Office of Metals Reserve for overquota production.

Mine production of gold, silver, copper, lead, and zinc in Arizona, 1942–46, and total, 1860–1946, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1942	515	163	33,920,731	253,651	$8,877,785	7,064,467	$5,023,621
1943	274	19	36,630,788	171,810	6,013,350	5,713,889	4,063,210
1944	226	17	35,900,641	112,162	3,925,670	4,394,039	3,124,650
1945	202	18	31,266,904	77,223	2,702,805	3,558,216	2,530,287
1946	194	33	31,058,179	79,024	2,765,840	3,268,765	2,641,162
1860–1946			[1]	10,868,159	267,880,720	292,687,414	217,264,699

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1942	786,774,000	$95,199,654	29,544,000	$1,979,448	37,044,000	$3,445,092	$114,525,600
1943	806,362,000	104,827,060	27,454,000	2,059,050	39,354,000	4,250,232	121,212,902
1944	716,606,000	96,741,810	33,414,000	2,673,120	58,154,000	6,629,556	113,094,806
1945	574,406,000	77,544,810	45,734,000	3,933,124	80,462,000	9,251,980	95,963,006
1946	578,446,000	93,708,252	47,860,000	5,216,740	87,330,000	10,654,260	114,986,254
1860–1946	[2] 11,178,092	3,309,276,802	[2] 374,057	48,361,132	[2] 277,470	53,373,921	3,896,157,274

[1] Figure not available.
[2] Short tons.

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1946, by months, in terms of recovered metals

Month	Gold (ounces)	Silver (ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
January	5,965	310,000	50,600,000	4,560,000	8,400,000
February	6,800	297,000	48,700,000	4,710,000	7,800,000
March	6,465	256,300	45,000,000	3,480,000	5,900,000
April	5,850	166,900	32,800,000	2,060,000	3,730,000
May	5,500	159,900	32,700,000	1,950,000	3,940,000
June	5,750	176,500	31,600,000	1,970,000	3,380,000
July	6,080	272,800	51,996,000	4,670,000	7,800,000
August	6,090	323,015	53,400,000	5,500,000	9,300,000
September	7,500	318,350	57,600,000	4,750,000	8,870,000
October	8,200	346,000	61,900,000	4,900,000	9,700,000
November	7,050	322,000	56,250,000	4,760,000	9,040,000
December	7,774	320,000	55,900,000	4,550,000	9,470,000
Total 1946	79,024	3,268,765	578,446,000	47,860,000	87,330,000

Gold and silver produced at placer mines in Arizona, 1942–46, in fine ounces, in terms of recovered metals

Year	Sluicing [1]		Drift mining		Dredges				Total	
					Dry-land [2]		Dragline floating [2]			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1942	885	176			35	5	1,916	217	2,836	398
1943	315	14	4						319	14
1944	242	90							242	90
1945	535	45	5						540	45
1946	88	2	9		116	14	185	46	398	62

[1] Includes placer sands treated by dry concentration plants.
[2] A floating washing plant supplied with gravel by a dragline excavator is called a "dragline dredge"; a stationary or movable washing plant supplied with gravel by any type of power excavator is called a "dry-land dredge."

Gold.—Compared with other Western States, gold mines in Arizona have been slow to resume production after being idle during the war years. In 1946 Congress Metals, Inc., did considerable rehabilitation at its 300-ton cyanide mill on the old Congress property; the mill began treating waste-dump ore and old tailings August 1. In 1946 more than 77 percent of the State gold output was recovered from copper ore, 16 percent from zinc-lead ore, more than 4 percent from siliceous ores, and most of the remainder from lead ore and from placers. Gold from copper ore declined slightly, but that from siliceous ores increased 51 percent and from zinc-lead ore 19 percent. Gold from placers decreased from 540 ounces to 398 ounces. The New Cornelia mine of the Phelps Dodge Corp., in Pima County, was by far the leading gold producer in Arizona; it was followed by the Iron King and United Verde mines in Yavapai County, the Magma mine in Pinal County, the Copper Queen (Bisbee) branch of the Phelps Dodge Corp. in Cochise County, the Morenci branch of the Phelps Dodge Corp. in Greenlee County, and the Castle Dome mine in Gila County; these seven properties (all copper mines except the Iron King) produced 86 percent of the State total gold.

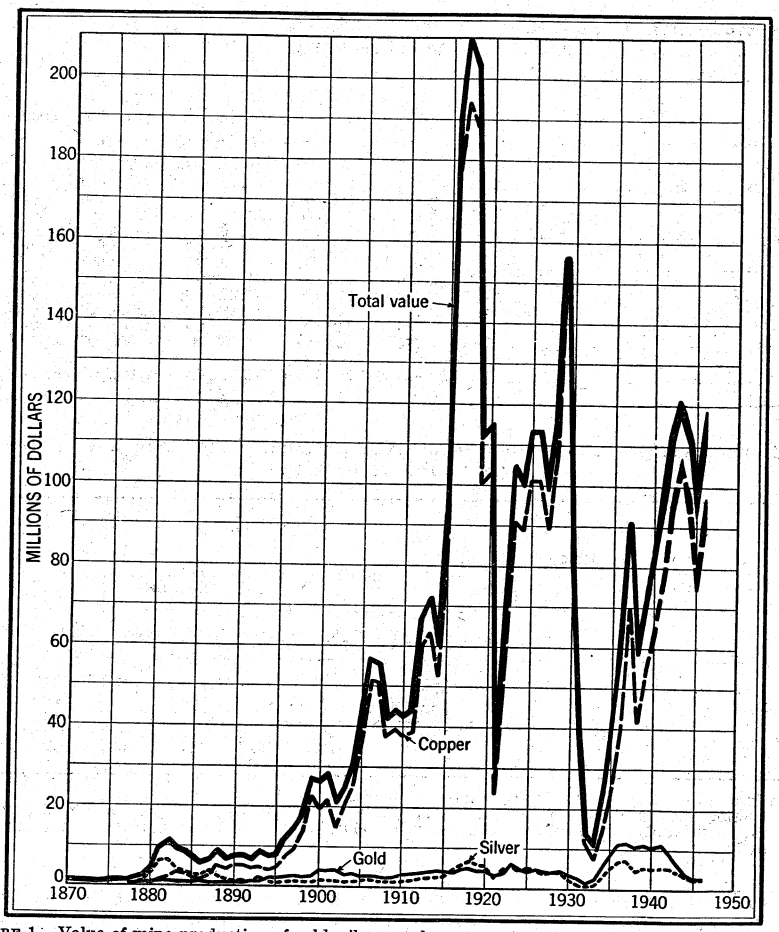

FIGURE 1.—Value of mine production of gold, silver, and copper and total value of gold, silver, copper, lead, and zinc in Arizona, 1870–1946. The value of lead and zinc has been less than $2,000,000 annually, except in a few years.

Silver.—The decrease of nearly 300,000 ounces in output of silver in Arizona in 1946 compared with 1945 resulted mainly from a marked decline in output of copper ore from the Copper Queen mine at Bisbee. Most of the silver produced in Arizona is a byproduct of copper ore and zinc-lead ore, and in 1946 these two classes of ore yielded 91 percent of the State total (copper ore yielded 54 percent and zinc-lead ore 37 percent); the remainder came principally from siliceous ores, lead ore, zinc-lead-copper ore, lead-copper ore, and zinc-copper ore. Silver from copper ore declined 348,979 ounces or 17 percent, and that from zinc-copper ore 58,071 ounces or 76 percent; however, the output of silver from zinc-lead ore increased 83,693 ounces or 7 percent, and that from siliceous ores 18,590 ounces or 13 percent. The Phelps Dodge Corp. continued to be the chief silver producer in Arizona, although its output was 11 percent less than in 1945; its four properties (Copper Queen, Morenci, New Cornelia, and United Verde) produced 63 percent of the State gold output, 54 percent of

the silver, and 55 percent of the copper. Other large silver producers in Arizona in 1946 were the Iron King, Magma, San Xavier (Eagle-Picher Mining & Smelting Co.), Trench-Flux, Castle Dome, and St. Anthony properties. Of the State total silver, 35 percent came from the Warren and Verde districts, but the output from these districts decreased 298,757 ounces from that in 1945.

Copper.—Although Arizona's output of copper was greater in 1946 than in 1945, the labor strike at some mines and smelters from March 20 to June 30, 1946, substantially affected the annual output. Production in 1946 was 578,446,000 pounds—an increase of 4,040,000 pounds or nearly 1 percent over 1945. The Copper Mountain (Morenci) district, with an output of 190,731,500 net pounds of copper, remained the leading copper-producing area in the State; it was followed by the Globe-Miami district with 177,111,500 pounds, Ajo with 90,465,000, Mineral Creek (Ray) with 32,709,000, Verde (Jerome) with 32,351,000, Pioneer (Superior) with 24,488,000, Eureka (Bagdad) with 11,864,500, and Warren (Bisbee) with 9,210,000. Marked increases in copper output from the Globe-Miami, Ajo, Pioneer (Superior), and Eureka (Bagdad) districts more than offset large decreases from the Warren (Bisbee), Copper Mountain (Morenci), Mineral Creek (Ray), and Verde (Jerome) districts. Copper ore and its products yielded 572,435,765 pounds of copper, as follows: 26,984,754 tons of copper ore treated by concentration yielded 81 percent; 432,354 tons of copper ore shipped crude to smelter, 6 percent; and 2,969,041 tons of copper ore leached and 10,851 tons of cement copper (from mine-water precipitates and underground leaching operations). 13 percent. The Morenci branch of the Phelps Dodge Corp. was again the largest copper producer in Arizona in 1946, although its output was less than in 1945 because of a labor strike; it was followed in order by the New Cornelia branch of the Phelps Dodge Corp., Inspiration, Castle Dome, Miami, Ray (Kennecott Copper Corp.), United Verde, Magma, Bagdad, and Copper Queen properties.

Lead and Zinc.—In spite of a labor strike at some zinc-lead mines in Arizona during the spring months of 1946, which resulted in a loss for the year of approximately 8,000,000 pounds of lead and 15,000,000 pounds of zinc, the State in 1946 exceeded its 1945 record output of both lead and zinc. Production of lead in 1946 (47,860,000 pounds) and zinc (87,330,000 pounds) was the largest in any year in the history of the State; the lead output exceeded the record output of 1945 by 2,126,000 pounds or 5 percent, and the zinc output by 6,878,000 pounds or 9 percent. These increases in both lead and zinc resulted principally from a greater output of zinc-lead ore from the Copper Queen mine of the Phelps Dodge Corp. at Bisbee. The property was by far the largest producer of lead and zinc in Arizona in 1946. Other large producers of lead, in order of output, were the St. Anthony property at Tiger, San Xavier mine near Sahuarita, Iron King mine at Humboldt, and Trench-Flux group near Patagonia. Other large producers of zinc, in order of output, were the Iron King, St. Anthony, San Xavier, Republic & Mammoth, Trench-Flux, Duquesne, and Abril properties. Of the State total, 45 percent of the lead and 51 percent of the zinc came from a mine at Bisbee in Cochise County, 20 percent of the lead and 10 percent of the zinc from a mine at Tiger in Pinal County, 9 percent of the lead and 12 percent of the zinc from a

mine at Humboldt in Yavapai County, and 10 percent of the lead and 8 percent of the zinc from a mine near Sahuarita in Pima County; most of the remaining lead and zinc output came from Santa Cruz, Mohave, Gila, and Graham Counties. About 90 percent of the total lead and 87 percent of the total zinc came from zinc-lead ore; 6 percent of the total lead came from lead ore and nearly all the rest of the lead from zinc-lead-copper ore, siliceous ores, lead-copper ore, zinc ore, and zinc-copper ore; and 8 percent of the total zinc came from zinc-copper ore, and nearly all the rest from zinc ore and zinc-lead-copper ore.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1946, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Cochise	16		6,698	$234,430	799,088	$645,663
Gila	21		3,834	134,190	192,167	155,271
Graham	1		125	4,375	8,969	7,247
Greenlee	4		4,689	164,115	314,427	254,057
Maricopa	4	1	41	1,435	21	17
Mohave	20	1	841	29,435	47,625	38,481
Pima	25		33,758	1,181,530	546,547	441,610
Pinal	14		7,877	275,695	350,802	283,448
Santa Cruz	12		137	4,795	156,036	126,077
Yavapai	70	22	20,661	723,135	817,869	660,838
Yuma	7	9	363	12,705	35,214	28,453
Total: 1946	194	33	79,024	2,765,840	3,268,765	2,641,162
1945	202	18	77,223	2,702,805	3,558,216	2,530,287

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Cochise	11,456,500	$1,855,953	23,310,000	$2,540,790	52,080,000	$6,353,760	$11,630,596
Gila	177,925,500	28,823,931	1,091,000	118,919	478,000	58,316	29,290,627
Graham	76,000	12,312	934,000	101,806	304,500	37,149	162,889
Greenlee	190,731,500	30,898,503					31,316,675
Maricopa			2,000	218			1,670
Mohave	884,000	143,208	764,000	83,276	1,976,500	241,133	535,533
Pima	93,219,000	15,101,478	4,804,000	523,636	8,127,000	991,494	18,239,748
Pinal	57,771,500	9,358,983	9,522,000	1,037,898	8,470,000	1,033,340	11,989,364
Santa Cruz	489,500	79,299	2,576,000	280,784	3,996,000	487,512	978,467
Yavapai	45,817,500	7,422,435	4,664,000	508,376	11,898,000	1,451,556	10,766,340
Yuma	75,000	12,150	193,000	21,037			74,345
Total: 1946	578,446,000	93,708,252	47,860,000	5,216,740	87,330,000	10,654,260	114,986,254
1945	574,406,000	77,544,810	45,734,000	3,933,124	80,452,000	9,251,980	95,963,006

MINING INDUSTRY

Although a serious labor strike during the spring months of 1946 held up mining of copper ore and zinc-lead ore in three of the principal copper and zinc-lead districts in Arizona, the effect on the annual output of these ores was not great. In fact, more zinc-lead ore was mined in 1946 than in any year in the history of the State; and the mining of copper ore, the most important part of the State mining industry, declined only 1 percent from that in 1945. The increase of approximately 35,000 tons in output of zinc-lead ore resulted principally from the mining of more zinc-lead ore from the Copper Queen

mine at Bisbee, San Xavier mine near Sahuarita, and St. Anthony property at Tiger. A shortage of labor still exists at most of the underground copper mines and at zinc-lead mines; however, some of the larger copper producers reported that the supply of labor was beginning to meet requirements at the close of the year. The total production of ore of all classes declined from 31,266,904 in 1945 to 31,058,179 in 1946. The output of copper ore was 30,386,149 tons—a 1-percent loss from 1945; zinc-lead ore, 515,047 tons—a 7-percent gain; zinc-copper ore, 63,854 tons—a 21-percent loss, lead ore, 13,441 tons—a 37-percent loss; zinc ore, 13,233 tons—a 48-percent gain; and zinc-lead-copper ore, 12,295 tons—a 7-percent gain. The output of siliceous ores was 53,094 tons compared with 19,506 tons in 1945—a 172-percent increase. Of the State total ore, 30,265,589 tons (97 percent) was copper ore mined in the Globe-Miami, Copper Mountain (Morenci), Ajo, Mineral Creek (Ray), Eureka (Bagdad), Verde (Jerome), Warren (Bisbee), and Pioneer (Superior) districts; 96 percent of the State total zinc-lead ore was mined in the Warren (Bisbee), Big Bug, Old Hat (Oracle), Harshaw, Pima, and Wallapai (Chloride) districts; all the zinc-lead-copper ore came from a mine in the Patagonia district; 84 percent of the zinc-copper ore came from a property in the Cochise (Dragoon) district; 54 percent of the zinc ore came from a mine in the Turquoise district; and 75 percent of the lead ore came from four properties in the Swisshelm, Aravaipa, and Castle Dome districts. More than 79 percent of the State total siliceous material was old tailings and waste-dump ore (gold) from the Martinez (Congress) district, old tailings (gold-silver) from the Tombstone district, and silver ore from the Ash Peak district. Mining operations at three open pits—Ajo, Miami (Castle Dome), and Morenci—produced 20,052,078 tons of copper ore in 1946 compared with 19,872,867 tons in 1945.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Arizona in 1946, with content in terms of recovered metals

Source	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	48	25,613	2,305	7,413	7,486	73,556	----------
Dry and siliceous gold-silver ore	11	13,327	987	50,804	36,718	370,150	----------
Dry and siliceous silver ore	14	14,154	272	107,827	75,201	56,058	----------
	73	53,094	3,564	166,044	119,405	499,764	----------
Copper ore	74	30,386,149	61,347	[1] 1,764,558	[2] 572,435,765	12,510	2,500
Lead ore	30	13,441	546	41,137	99,047	2,807,124	----------
Lead-copper ore	2	1,066	73	21,886	97,800	299,827	----------
Zinc ore	7	13,233	111	12,294	123,874	91,238	2,398,040
Zinc-copper ore	6	63,854	27	17,951	1,905,067	25,800	7,345,275
Zinc-lead ore	29	515,047	12,917	1,205,685	3,337,042	43,255,402	75,919,185
Zinc-lead-copper ore	1	12,295	41	39,148	328,000	868,335	1,665,000
Total lode mines	[3] 194	31,058,179	78,626	[1] 3,268,703	[2] 578,446,000	47,860,000	87,330,000
Placers	33	----------	398	62	----------	----------	----------
Total: 1946	227	31,058,179	79,024	3,268,765	578,446,000	47,860,000	87,330,000
1945	220	31,266,904	77,223	[4] 3,558,216	[5] 574,406,000	45,734,000	80,452,000

[1] Includes 475 ounces recovered from underground mine-water precipitates.
[2] Includes 73,554,391 pounds recovered from ore leached and mine-water precipitates.
[3] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[4] Includes 322 ounces recovered from underground mine-water precipitates.
[5] Includes 56,344,468 pounds recovered from ore leached and mine-water precipitates.

METALLURGIC INDUSTRY

Of the 31,058,179 tons of ore produced in 1946 in Arizona, 27,593,067 tons (89 percent) were treated at 30 concentration plants, 2,969,041 tons (more than 9 percent) at 3 leaching plants, 23,505 tons at 3 cyanidation plants, and 83 tons at 3 amalgamation plants; 472,483 tons (more than 1 percent) were shipped crude to smelters.

Ore treated at concentration plants in 1946 comprised chiefly 26,984,754 tons of copper ore, 515,046 tons of zinc-lead ore, 63,854 tons of zinc-copper ore, 12,566 tons of zinc ore, and 12,295 tons of zinc-lead-copper ore. Copper ore from the Miami property was treated by a combination of leaching and concentration, copper ore from the Inspiration mine was treated by straight leaching and by leaching and concentration, and copper ore from the Emerald Isle and Troy mines was treated by straight leaching. The large copper-concentration plants at Ajo (25,000-ton-a-day), Clarkdale (2,100-ton), Hayden (10,000-ton), Miami (18,000-ton), Inspiration (18,000-ton), Castle Dome (10,000-ton), Bagdad (3,000-ton), and Superior (850-ton), and the copper-leaching plants at Inspiration (9,000-ton) and Miami (3,000-ton) were operated continuously in 1946, most of them at a higher rate than in 1945. The 45,000-ton copper concentrator and smelter at Morenci and the copper smelter at Douglas were idle from March 20 to June 30, owing to a labor strike; however, the copper smelters at Clarkdale, Hayden, and Miami operated continuously and the copper smelter at Superior intermittently. Most of the copper concentrates produced at mills in Arizona are treated at smelters in Arizona, but all the lead concentrates produced at mills in Arizona in 1946 were shipped to the smelter at El Paso, Tex., and all the zinc concentrates were shipped to smelters at Amarillo, Dumas, and Corpus Christi, Tex.; Bartlesville, Okla.; Great Falls and Anaconda, Mont.; East St. Louis, Ill.; and Fort Smith, Ark.

The following tables give details of the treatment of all ores produced in Arizona in 1946.

Mine production of metals in Arizona in 1946, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore amalgamated	83	194	33			
Ore and old tailings cyanided	23,505	889	6,823			
Concentrates smelted	1,008,835	62,422	2,493,508	471,549,204	44,434,907	87,070,205
Ore smelted	472,483	15,121	767,864	33,342,405	3,425,093	259,795
Copper precipitates smelted	10,851		475	[1] 16,492,429		
Copper ore leached	[2] 2,969,041			57,061,962		
Placer		398	62			
Total: 1946		79,024	3,268,765	578,446,000	47,860,000	87,330,000
1945		77,223	3,558,216	574,406,000	45,734,000	80,452,000

[1] Distributed as follows: Cochise County, 398,000 pounds; Gila County, 7,797,700 pounds; Greenlee County, 731,575 pounds; Mohave County, 215,500 pounds; Pinal County, 7,062,754 pounds; and Yavapai County, 286,900 pounds.

[2] Treated by straight leaching at 1 plant in Gila County, 1 plant in Mohav County, and 1 plant in Pinal County.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment in Arizona in 1946, by types of mills and by counties, in terms of recovered metals.

AMALGAMATION MILLS

County	Material treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal					
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Gila	3	5	1						
Santa Cruz	75	10	8						
Yavapai	4	6	1						
Yuma	1	173	23						
Total: 1945	83	194	33						
1946	6	25	5						

CYANIDATION MILLS

Mohave	1,500	31	4,006						
Pinal	5	1	5						
Yavapai	22,000	857	2,812						
Total: 1946	23,505	889	6,823						
1945	200	4	455						
Grand total: 1946	23,588	1,083	6,856						
1945	206	29	460						

Mine production of metals from concentrating mills in Arizona in 1946, by counties, in terms of recovered metals

County	Material treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Cochise	273,284	79,576	1,810	509,082	3,259,780	21,478,103	52,080,000
Gila	8,555,898	164,062	3,404	175,244	111,329,389	714,515	478,000
Graham	3,592	428	22	668	7,360	110,000	304,500
Greenlee	9,569,178	351,827	4,400	263,000	189,200,000		
Mohave	19,772	4,018	520	30,437	391,221	746,884	1,976,500
Pima	6,401,404	166,063	33,260	521,324	91,225,207	4,727,300	8,127,000
Pinal	1,563,392	107,502	6,707	295,283	46,318,000	9,491,030	8,470,000
Santa Cruz	39,113	6,626	69	148,573	403,245	2,450,545	3,996,000
Yavapai	1,165,434	128,585	12,230	547,103	29,415,002	4,572,530	11,638,205
Yuma	2,000	148		2,794		144,000	
Total: 1946	27,593,067	1,008,835	62,422	2,493,508	471,549,204	44,434,907	87,070,205
1945	28,098,648	1,013,484	51,573	2,393,737	460,719,258	43,397,346	80,032,845

Gross metal content of concentrates produced from ores mined in Arizona in 1946, by classes of concentrates smelted

Class of concentrates	Concentrates produced (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Copper	863,501	51,601	1,374,605	480,155,648	44,473	5,083,178
Lead	45,879	10,144	989,521	3,022,720	41,977,256	8,152,589
Lead-copper	994	30	37,396	273,872	906,968	320,289
Zinc	93,639	2,601	372,224	1,778,369	5,314,380	97,271,747
Zinc-lead	77	3	1,286	3,888	45,250	59,635
Iron	4,745	1,339	10,475	6,438	109,667	631,013
Total: 1946	1,008,835	65,718	2,785,507	485,240,935	48,397,994	111,518,451
1945	1,013,484	53,973	2,612,158	474,136,202	48,446,431	105,134,562

Mine production of metals from Arizona concentrates shipped to smelters in 1946, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Cochise	79,576	1,810	509,082	3,259,780	21,478,103	52,080,000
Gila	164,062	3,404	175,244	111,329,389	714,515	478,000
Graham	428	22	668	7,360	110,000	304,500
Greenlee	351,827	4,400	263,000	189,200,000	----------	----------
Mohave	4,018	520	30,437	391,221	746,884	1,976,500
Pima	166,063	33,260	521,324	91,225,207	4,727,300	8,127,000
Pinal	107,502	6,707	295,283	46,318,000	9,491,030	8,470,000
Santa Cruz	6,626	69	148,573	403,245	2,450,545	3,996,000
Yavapai	128,585	12,230	547,103	29,415,002	4,572,530	11,638,205
Yuma	148	----------	2,794	----------	144,000	----------
Total: 1946	1,008,835	62,422	2,493,508	471,549,204	44,434,907	87,070,205
1945	1,013,484	51,573	2,393,737	460,719,258	43,397,346	80,032,845

BY CLASSES OF CONCENTRATES

Copper	863,501	49,270	1,238,710	467,665,160	27,165	----------
Lead	45,879	10,144	989,521	2,560,265	40,024,008	----------
Lead-copper	994	30	37,396	242,670	846,245	----------
Zinc	93,639	1,636	216,195	1,072,604	3,397,304	87,017,625
Zinc-Lead	77	3	1,211	3,305	36,010	49,630
Iron	4,745	1,339	10,475	5,200	104,175	2,950
Total 1946	1,008,835	62,422	2,493,508	471,549,204	44,434,907	87,070,205

Gross metal content of Arizona crude ore shipped to smelters in 1946, by classes of ore

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	1,885	1,138	4,255	7,988	16,446	16,665
Dry and siliceous gold-silver	13,027	980	50,203	44,633	405,936	----------
Dry and siliceous silver	12,754	243	104,009	81,278	78,004	51,167
Copper	432,354	12,134	545,389	34,972,040	50,247	5,129,660
Lead	10,729	546	38,037	117,633	2,758,806	1,088,823
Lead-copper	1,066	73	21,886	115,059	315,929	39,225
Zinc	667	7	4,071	36,385	56,930	358,741
Zinc-lead	1	----------	14	----------	261	296
Total: 1946	472,483	15,121	767,864	35,375,016	3,682,559	6,684,577
1945	690,579	25,081	1,163,652	60,925,006	2,554,502	7,149,394

Mine production of metals from Arizona crude ore shipped to smelters in 1946, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Cochise	91,124	4,888	289,846	7,798,720	1,831,897	
Gila	39,164	425	16,607	1,736,449	376,485	
Graham	3,815	103	8,301	68,640	824,000	
Greenlee	44,111	289	51,427	799,925		
Maricopa	82	40	21		2,000	
Mohave	4,058	286	13,182	277,279	17,116	
Pima	46,035	498	25,223	1,993,793	76,700	
Pinal	39,923	1,169	55,514	4,390,746	30,970	
Santa Cruz	2,344	58	7,455	86,255	125,455	
Yavapai	199,406	7,202	267,891	16,115,598	91,470	259,795
Yuma	2,421	163	32,397	75,000	49,000	
Total: 1946	472,483	15,121	767,864	33,342,405	3,425,093	259,795
1945	690,579	25,081	1,163,652	57,342,274	2,336,654	419,155

BY CLASSES OF ORE

Dry and siliceous gold	1,885	1,138	4,255	7,224	15,106	
Dry and siliceous gold-silver	13,027	980	50.203	36,718	365,150	
Dry and siliceous silver	12,754	243	104,009	75,201	56,058	
Copper	432,354	12,134	545,389	32,995,643	12,510	
Lead	10,729	546	38,037	98,919	2,620,274	
Lead-copper	1,066	73	21,886	97,800	299,827	
Zinc	667	7	4,071	30,900	55,960	259,595
Zinc-lead	1		14		208	200
Total 1946	472,483	15,121	767,864	33,342,405	3,425,093	259,795

REVIEW BY COUNTIES AND DISTRICTS

COCHISE COUNTY

Cochise District.—Continuous operations at the Republic and Mammoth mines, by the Coronado Copper & Zinc Co., resulted in a substantial increase in production of silver, copper, and zinc in the Cochise district in 1946 over 1945. The company reported that 53,655 tons of zinc-copper ore were treated in its 150-ton flotation mill, which yielded 5,930 tons of zinc concentrate and 2,163 tons of copper concentrate. In addition, 4,454 tons of copper ore were shipped direct to a smelter. The rest of the district output was a small lot of lead ore produced from the Johnson claim.

Dos Cabezas and Tevis District.—A lessee continued to operate the Elma claim of the Tout group and shipped seven cars (330 tons) of highly siliceous copper ore to smelters in Arizona and Texas.

Hartford (Huachuca Mountains) District.—The output of the Hartford district in 1946 was all zinc-lead ore (387 tons) produced from the Cave Creek Canyon and State of Texas properties and treated in the Shattuck Denn custom mill at Bisbee.

Swisshelm District (Elfrida).—Lessees operated the Scribner and Chance properties throughout the year and shipped 4,189 tons of oxide silver-lead ore to the lead smelter at El Paso, Tex.; 3,039 tons came from the Scribner mine and 1,150 tons from the Chance property.

Mine production of gold, silver, copper, lead, and zinc in Arizona in 1946, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total (value)
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Cochise County:													
California	1		1				5		5	500			$85
Cochise	2		58,110				12,062		12,062	1,974,500	200	5,753,500	1,031,564
Dos Cabezas and Tevis	1		330	66		66	2,271		2,271	96,500	2,200		20,018
Hartford (Huachuca Mountains)	2		387	1		1	625		625	2,500	24,600	55,500	10,397
Swisshelm	2		4,189	256		256	16,766		16,766	6,000	1,115,000		145,014
Tombstone	2		11,753	626		626	37,646		37,646	27,500	383,000		98,530
Turquoise	3		7,623	69		69	8,578		8,578	139,000	8,000	1,523,000	218,542
Warren	3		282,015	5,680		5,680	721,135		721,135	9,210,000	21,777,000	44,748,000	10,106,446
Gila County:													
Banner and Dripping Springs	5		24,538	375		375	19,974		19,974	805,500	950,000	478,000	321,621
Globe-Miami	13		11,519,345	3,403		3,403	172,115		172,115	177,111,500	141,000		28,965,606
Green Valley	2		106	44		44	26		26	4,500			2,290
Spring Creek	1		57	12		12	52		52	4,000			1,110
Graham County:													
Aravaipa	1		7,407	125		125	8,969		8,969	76,000	934,000	304,500	162,889
Greenlee County:													
Ash Peak	1		8,571	225		225	49,271		49,271				47,686
Copper Mountain (Morenci)	2		9,604,713	4,462		4,462	265,151		265,151	190,731,500			31,268,915
Metcalf	1		5	2		2	5		5				74
Maricopa County:													
Gila Bend Mountains	1		2				5		5		2,000		222
Pikes Peak	1		1	3		3							105
Vulture		1			1	1							35
White Butte	1		17	21		21							735
Wickenburg	1		62	16		16	16		16				573
Mohave County:													
Cedar Valley	2		8,796	37		37	5,156		5,156	488,000	25,800	1,005,500	210,000
Gold Basin		1			4	4							140
Indian Secret	1		1,400	29		29	3,818		3,818				4,100
Music Mountain	1		34	37		37	224		224		1,200		1,607
Owens	2		101	2		2	10		10	5,500			969
Wallapai	13		34,899	730		730	38,229		38,229	390,500	737,000	971,000	318,495
Weaver	1		100	2		2	188		188				222
Pima County:													
Ajo	1		6,344,842	33,083		33,083	390,401		390,401	90,465,000			16,128,679
Amole	2		3,214	167		167	4,313		4,313	3,500	128,000	200,000	48,249
Arivaca	2		212	67		67	505		505		400		2,797
Cababi	2		228	32		32	625		625	8,000			2,921
Cerro Colorado	1		42				1,484		1,484	500	1,000		1,389
Empire	2		307	3		3	474		474	1,500	33,000		4,328
Greaterville	1		110	2		2	302		302	500	7,600	11,000	2,565
Helvetia (Rosemont)	6		44,577	382		382	12,714		12,714	1,904,000		20,000	334,531
Old Hat [1]	2		1,322	14		14	1,651		1,651	118,000			20,940
Pima (Sierritas, Papago, Twin Buttes)	4		49,799	5		5	125,125		125,125	609,000	4,592,000	7,896,000	1,663,774
Roskruge and Waterman	1		2,625	3		3	7,640		7,640	100,500	30,000		25,829
Silver Bell	1		161				1,313		1,313	8,500	12,000		3,746

Pinal County:													
Casa Grande	1		5	1		1	5		5				39
Dripping Springs	1		60							500			81
Martinez Canyon	1		574				115		115		51,000		5,652
Mineral Creek (Ray)	3		1,314,821	308		308	23,219		23,219	32,709,000	10,000		5,329,489
Mineral Hill	1		24				271		271				219
Old Hat[1]	2		86,051	307		307	83,510		83,510	568,000	9,461,000	8,470,000	2,234,826
Pioneer (Superior)	4		201,761	7,260		7,260	243,667		243,667	24,488,000			4,418,039
Summit	1		84	1		1	15		15	6,000			1,019
Santa Cruz County:													
Harshaw	2		25,227	17		17	105,672		105,672	72,000	1,384,000	2,256,500	523,791
Oro Blanco	2		641	25		25	4,094		4,094	6,000	104,000	32,000	20,395
Palmetto	1		640							26,500			4,293
Patagonia (Duquesne)	4		13,293	58		58	41,479		41,479	362,000	901,000	1,665,000	395,528
Tyndall	3		1,731	37		37	4,791		4,791	23,000	187,000	42,500	34,460
Yavapai County:													
Agua Fria	3		9,664	62		62	1,313		1,313	476,500			80,424
Big Bug	7	4	119,114	8,554	75	8,629	338,052	10	338,062	595,000	4,310,000	10,468,000	2,418,445
Black Canyon	3	1	83	35	2	37	1,063		1,063	1,000	800	2,500	2,708
Black Rock	1		6	3		3	78		78				168
Blue Tank		3			12	12							420
Bullard (Pierce)	1		3	2		2							70
Castle Creek	2	1	12	5	4	9	5		5	1,000			481
Cherry Creek	1		17	10		10	5		5				354
Copper Basin	2		10,481	8		8	1,240		1,240	459,500	23,400	307,000	115,726
Eureka (Bagdad)	6	2	864,375	150	7	157	31,182		31,182	11,864,500	115,200	649,500	2,044,535
Hassayampa (Groom Creek, Hassayampa River, Senator, Prescott)	8	3	635	318	194	512	3,729	47	3,776	5,000	48,000	42,500	32,198
Humbug		1			2	2							70
Lynx Creek		1			53	53		5	5				1,859
Martinez	2		22,002	859		859	2,813		2,813				32,338
Mineral Point	1		2	1		1							35
Pine Grove	5		8,877	1,762		1,762	18,161		18,161	55,500	155,000	424,500	154,019
Silver Mountain	2		41	8		8	42		42		1,700		499
Squaw Peak	1		378				42		42	6,500			1,087
Tiger	1		1	3		3	5		5				109
Tip Top	1		1				26		26				21
Turkey Creek	1		15	26		26	302		302	1,000			1,316
Verde (Jerome)	4		350,465	8,132		8,132	418,578		418,578	32,351,000			5,863,693
Walker	8	2	181	96	4	100	510		510	500	5,000	4,000	5,026
Walnut Grove (Hassayampa River)		2			7	7							245
Weaver	6	2	448	249	6	255	224		224				9,106
White Picacho	4		43	12		12	437		437	500	4,900		1,388
Yuma County:													
Castle Dome	1		2,019				3,349		3,349		169,000		21,127
Dome		1			4	4							140
Ellsworth (Harqua Hala)	3		1,322	111		111	375		375	73,000			16,014
LaPaz		1			2	2							70
Middle Camp		1			3	3							105
Plomosa	3	5	1,081	225	17	242	31,490		31,490	2,000	24,000		36,854
Trigo		1			1	1							35
Total Arizona	194	33	31,058,179	78,626	398	79,024	3,268,703	62	3,268,765	578,446,000	47,860,000	87,330,000	114,986,254

[1] Old Hat district lies in both Pima and Pinal Counties.

Tombstone District.—Most of the output in the Tombstone district in 1946 was old siliceous tailings (11,590 tons), containing 622 ounces of gold, 37,000 ounces of silver, 34,300 pounds of copper, and 400,000 pounds of lead, shipped to a smelter from the Grand Central dump near Fairbank. A lessee operated the Tombstone Extension mine a few months and shipped 163 tons of oxide silver-lead ore to the smelter at El Paso.

Turquoise District (Courtland, Pearce, Gleeson).—The principal operation in the Turquoise district in 1946 was the development of the Abril mine near Pearce by the Shattuck Denn Mining Corp. During the year the company hauled 7,123 tons of zinc ore from this mine to its custom flotation mill at Bisbee. According to the corporation annual report for 1946, exploration was carried on at the mine during most of the year and is continuing. Although the mine has not progressed very far beyond the status of a prospect, substantial quantities of ore have been proved and indicated; the metallic value so far has been almost entirely zinc. Nearly all the rest of the district output was crude copper ore shipped to a smelter; 377 tons came from the Tom Scott mine and 122 tons from the Shannon group.

Warren District (Bisbee, Warren).—The value of the metal output of the Warren district decreased from $10,407,940 in 1945 to $10,106,446 in 1946, owing to the marked decline in output of copper ore from the Copper Queen mine, which not only caused a large drop in production of copper but also in gold and silver. However, the district made a record output of lead and zinc, in consequence of a notable increase in the production of zinc-lead ore from the Copper Queen branch of the Phelps Dodge Corp. The corporation reported that 46,560 tons of copper ore were mined and smelted in 1946 compared with 185,394 tons in 1945 and that 211,956 tons of zinc-lead ore were treated in flotation mills in Arizona and New Mexico compared with 177,513 tons. In addition, 1,036 tons of lead-copper ore were shipped direct to the smelter at El Paso, and 444 tons of copper precipitates were produced by surface and underground precipitation plants and sent to the corporation smelter at Douglas. During the last quarter of the year, all zinc-lead ore produced by the corporation was treated in its own flotation mill, as plant capacity was increased from 450 tons to 900 tons a day.

According to the corporation annual report for 1946, production during the first 6 months of the year was drastically reduced, caused partly by a shortage of labor but principally by a labor strike from March 20 to June 30. During the year, only 46,560 tons of copper ore were mined. However, the output of zinc-lead ore increased 35,479 tons. The shortage of labor and the strike not only affected production adversely but also curtailed exploration. There was little change in the reserves of copper ore, but zinc-lead ore developments continued favorable. The improvement in the labor supply at the end of the year, if continued, will enable mining operations, including development, to be expanded in the copper areas, without interfering with the prevailing rate of zinc-lead production.

The Denn mine of the Shattuck Denn Mining Corp. was closed in March on account of a labor strike and remained closed throughout the remainder of the year. During the first quarter of the year the corporation shipped 21,700 tons of copper ore to the smelter at El

Paso and treated 99 tons of zinc-lead ore in its 150-ton flotation mill. The mill was utilized almost entirely for treating custom ores, and during the year it handled 30,532 tons of ore, which yielded 375 tons of copper concentrate, 2,728 tons of lead concentrate, and 6,364 tons of zinc concentrate. About 52 percent of the ore was zinc-lead ore from the Copper Queen mine at Bisbee and the remainder mainly zinc ore from the Abril mine near Pearce, zinc-lead ore from the "79" mine near Hayden, and zinc-copper ore from the Copper World mine near Yucca. According to the corporation annual report for 1946, the Denn mine was sold to the Phelps Dodge Corp. March 8, 1947.

The rest of the district output was 331 tons of copper ore and 279 tons of lead ore produced from the Shattuck mine by a lessee.

GILA COUNTY

Banner and Dripping Springs District.—The main output in the Banner and Dripping Springs district continued to be high-lime fluxing ore (19,921 tons in 1946), containing an average of 1.95 percent copper to the ton, mined from the Christmas mine by Sam Knight Mining Lease, Inc. The ore is shipped to the copper smelter at Hayden where it is needed for fluxing purposes. The remainder of the district output comprised 3,812 tons of zinc-lead ore and 615 tons of lead ore produced from the "79" mine by the 79 Lead-Copper Co., 170 tons of gold ore from the Round Top and Iron Butte properties, and 20 tons of copper ore from the Idaho claim.

Globe-Miami District.—The Globe-Miami district, with a production of 177,111,500 net pounds of copper in 1946 (157,291,400 net pounds in 1945) continued to rank second among the important copper-producing areas in Arizona; the Copper Mountain (Morenci) district in Greenlee County remained in first place. The Inspiration property, with a yield of 61,658,590 net pounds of copper (53,292,670 net pounds in 1945), was the chief copper producer in the district and ranked third in the State. The Inspiration Consolidated Copper Co. reported that 3,176,483 tons of copper ore were treated in 1946 compared with 3,852,543 tons of copper ore and tailings in 1945. Of the total ore, 2,948,981 tons, averaging 1.112 percent copper—0.565 percent copper as oxide and 0.547 percent as sulfide—from which the slimes had been removed, were treated in the main leaching plant; the ore was leached by acid ferric sulfate. Slimes (226,822 tons, averaging 1.254 percent copper) removed from ore at the main leaching plant were treated in the company flotation concentrator for extraction of the sulfide copper content, and the tailings from this operation were leached by sulfuric acid solution for extraction of oxide copper content. In addition, 680 tons of crude copper ore were sent direct to the smelter at Miami. The total copper production per ton of ore treated in 1946 was 19.625 pounds. The labor supply, especially in the mining division, gradually improved as the year progressed, with a consequent rise in production.

According to the annual report of the company for 1946, ore mined during the year totaled 3,182,809 dry tons, assaying 1.122 percent copper—0.587 percent as oxide and 0.535 percent as sulfide. Of the total ore mined, 110,384 tons were from development. Total underground development aggregated 38,019 feet of drifts and

raises and 3,448 cubic yards of miscellaneous development. During the last 4 months of the year, 1,633 feet of diamond drilling were done for development purposes. Studies during the year in connection with future mining plans in certain areas of the ore body showed that the application of open-pit mining in those areas would be economically preferable to mining by underground methods. A proposed plan for such open-pit mining has been approved, and preparatory work is in progress.

The Castle Dome Copper Co., Inc., a wholly owned subsidiary of the Miami Copper Co., and the Miami mine of the Miami Copper Co. ranked second and third, respectively, in copper production in the district. The Miami Copper Co. reported that 56,590,107 net pounds of copper (53,341,226 net pounds in 1945) were produced from the Castle Dome property in 1946 and 56,515,534 net pounds of copper (48,066,662 net pounds in 1945) from the Miami mine.

According to the annual report of the Miami Copper Co. for 1946, the Castle Dome open pit and 12,000-ton concentrator were operated at full capacity 3 shifts a day 7 days a week throughout the year, except for national holidays and minor shut-downs. The mill treated 4,102,566 tons of ore averaging 0.79 percent copper. In addition to copper, the concentrate contained 2,111 ounces of gold and 99,595 ounces of silver. Ore reserves as of January 1, 1947, are estimated to be 14,901,000 tons averaging 0.726 percent copper. Exploration of the area lying southwest of the Castle Dome ore body was completed during the year. From the information obtained by drilling of 43 churn-drill holes with an aggregate footage of 13,508 feet, it is estimated that 6,127,000 tons of ore averaging 0.704 percent copper have been developed in addition to the ore reserves mentioned above. To mine this ore body considerable expense for stripping and equipment would be required, and the cost of mining would be higher than that at the Castle Dome ore body.

Mining and milling at the Miami mine of the Miami Copper Co. were continuous throughout the year. The company's 18,000-ton concentrator and 3,000-ton leaching plant treated 4,222,698 tons of ore averaging 0.734 percent copper, and 2,688 tons of copper precipitates were produced from leaching of ore in place. In addition, 654 tons of molybdenum concentrate were recovered as a byproduct in treating copper ore. Sufficient labor was available throughout the year, and mine development and the undercutting of the ore body in preparation for mining progressed at a rate suitable for mining requirements. The pilot plant for manufacturing a solvent to be used in recovering the sulfide copper remaining in the mined-out areas was operated intermittently during the year. From the results obtained, it would appear that, after certain mechanical changes in its design, the process developed for the manufacture of such a solvent is practicable. Ore reserves, as of January 1, 1947, are estimated to be 36,794,000 tons averaging 0.865 percent copper.

The rest of the district output was principally 16,965 tons of copper ore shipped direct to smelters; 12,746 tons came from various claims and waste dumps of the Old Dominion property, 2,819 tons from the Carlota mine, and 1,400 tons from the Superior & Boston property. A total of 313 tons of lead ore was shipped from the Albert Lea and Defiance mines and 206 tons of silver ore from the Rescue mine.

Green Valley District.—Summit Copper Mines, Inc., continued working the Summit mine near Payson and shipped 82 tons of gold ore to smelters in Arizona. Leasing operations at the Cracker Jack mine produced 24 tons of copper ore.

Spring Creek (Young) District.—The Wild Bull mine near Young was operated a few months in 1946, and 57 tons of copper ore were shipped to smelters in Arizona.

GRAHAM COUNTY

Aravaipa District.—Mining and development of zinc-lead ore were carried on throughout the year at the Aravaipa group near Klondyke by the Athletic Mining Co. The company reported that 3,815 tons of zinc-lead ore were shipped to the lead smelter at El Paso, Tex.; and 3,592 tons of lower-grade zinc-lead ore were treated in the Eagle-Picher flotation mill near Sahuarita.

GREENLEE COUNTY

Ash Peak District.—The Ash Peak Lease continued operating the Ash Peak mine near Duncan and shipped 8,571 tons of fluxing ore to the International copper smelter at Miami. The ore averaged 0.026 ounce of gold and 5.75 ounces of silver to the ton and 81.20 percent silica.

Copper Mountain District (Morenci).—The Copper Mountain district, with a production of 190,731,500 net pounds of copper in 1946 (201,652,200 net pounds in 1945), remained the chief copper-producing area in Arizona. The Morenci mine of the Phelps Dodge Corp. continued to be the outstanding producer of copper in the State despite the decrease of more than 5 percent caused by a labor strike from March 20 to June 30. The corporation reported that 9,569,178 tons of copper ore were treated in the combined (Phelps Dodge and Reconstruction Finance Corporation) 45,000-ton concentrator and that 35,492 tons of crude copper ore and 690 tons of copper precipitates were shipped direct to the Morenci smelter. In addition to copper, the mine was an important producer of gold and silver.

According to the annual report of the Phelps Dodge Corp. for 1946, a marked improvement in labor supply, following resumption of work in July after the labor strike ended, made possible a progressive increase in the scale of operations at the Morenci branch; at the end of the year near-capacity operation was attained. These favorable conditions in the late months of the year permitted the productive potentialities of the open-pit mine and reduction works to be realized. Copper ore mined totaled 9,604,670 tons and waste and leach material stripped 11,836,545 tons; the ratio of waste to ore was 1.23. The grade and tonnage of ore mined, compared with estimates, continued favorable. Preparatory work for the opening of the 4,550 level was started. A program of metallurgical research is being carried on for further improvement in concentrating practices and metal recoveries.

The remainder of the district output was 43 tons of crude gold-silver ore shipped from the Climax Lode claim.

MARICOPA COUNTY

White Butte District.—A little development was done in 1946 at the Charlotte claim resulting in the shipments of small lots of gold ore.

Wickenburg District.—The only output in the Wickenburg district continued to be old tailings containing principally gold.

MOHAVE COUNTY

Cedar Valley District.—Copper ore and zinc-copper ore were mined throughout the year at the Copper World mine, 16 miles east of Yucca, by the Dye & Bathrick Mining Co. The company shipped 4,484 tons of zinc-copper ore to custom flotation mills in Arizona, Nevada, and Utah, where it was separated into copper concentrate and zinc concentrate, and 2,002 tons of copper ore to a smelter in Arizona. The total ore contained 28 ounces of gold, 4,471 ounces of silver, 448,919 pounds of copper, 35,500 pounds of lead, and 1,261,600 pounds of zinc. Zinc-copper ore was mined also from the Antler mine by the Arizona Antlers Mining Co.; 2,310 tons of ore were shipped to custom flotation mills in Arizona and Utah.

Indian Secret (White Hills) District.—The White Hills Leasing Co. operated the White Hills group north of Chloride a few months in 1946 and treated 1,400 tons of silver ore in a cyanide mill.

Music Mountain District.—Lessees worked the Music Mountain group near Hackberry a short time in 1946 and shipped 34 tons of gold ore to a smelter.

Owens (McCracken and Potts Mountain) District.—A lessee continued to operate the Stein mine and shipped 100 tons of copper ore to the smelter at Hayden, and a small lot of gold ore was produced from the Golden Midas claim.

Wallapai District (Cerbat, Chloride, Mineral Park, Stockton Hill).—The output of the Wallapai district in 1946 comprised 20,698 tons of copper ore, 11,588 tons of zinc-lead ore, 1,390 tons of zinc ore, 993 tons of gold-silver ore, 136 tons of gold ore, 49 tons of silver ore, and 45 tons of lead ore. All of the copper ore was produced from the Emerald Isle mine by the Emerald Isle Copper Co.; most of it was treated by sulfuric acid in the company 300-ton leaching plant. However, the mine was closed in June. Ralph R. Langley worked his Summit group throughout the year and hauled 4,563 tons of zinc-lead ore to the Mineral Park custom flotation mill near Chloride, where it was separated into lead concentrate and zinc concentrate. About 3,555 tons of ore, averaging 0.05 ounce of gold and 2.50 ounces of silver to the ton, 4.15 percent lead, and 7.03 percent zinc, were produced from the Tennessee mine by the Miners Co-operative Association and treated in the company 150-ton flotation mill. The mill yielded 223 tons of lead concentrate and 413 tons of zinc concentrate. Other producers of zinc-lead ore included the Lone Jack mine (1,740 tons), Silver Hill mine (1,246 tons), and El Oro mine (468 tons). The rest of the district output was mainly 1,314 tons of zinc ore produced from the Columbus mine and 866 tons of gold-silver ore from the White Eagle mine. The Mineral Park Milling Co. operated its 100-ton flotation mill near Chloride continuously on custom ores purchased from various operators in the district; the mill treated a total of 9,256 tons of ore.

Weaver District.—In 1946 about 100 tons of low-grade gold-silver ore from the Dixie Queen & Rock property were treated in a cyanide mill.

PIMA COUNTY

Ajo District.—All the output of the Ajo district was copper ore from the New Cornelia mine of the Phelps Dodge Corp. In 1946 the district ranked first in gold and third in copper and silver output in the State. According to the annual report of the Phelps Dodge Corp. for 1946, operations at the New Cornelia Branch were not affected by labor strikes but were continuous throughout the year. Copper-ore production and waste removal were curtailed in the early months by labor shortages but were increased during the latter half of the year by improved manpower supply; at the close of the year operations approached a normal rate. Production in 1946 was 6,339,294 tons of copper ore and 5,221,756 tons of waste, a total of 11,561,050 tons and an increase of 2,750,030 tons over the 1945 tonnage. The company 25,000-ton concentrator treated 6,344,842 tons of copper ore in 1946 compared with 5,256,445 tons in 1945.

Amole District.—The old Palo Verde mine, 11 miles west of Tucson, was operated during the first 4 months of the year, and 1,574 tons of zinc-lead ore were hauled to the Eagle-Picher mill near Sahuarita. Ore (1,640 tons) from the Old Yuma waste dump, containing chiefly gold and lead, was treated in a concentration mill near Tucson.

Arivaca District.—C. R. Leikem operated the Tiger mine a few months in 1946, shipped 178 tons of gold ore to smelters in Arizona, and sold 4 tons of high-grade lead ore to an ore buyer in Douglas. Gold ore (30 tons) was produced also from the Fortuna mine.

Cababi District.—Virtually all the output in the Cababi district in 1946 was 227 tons of gold-silver ore shipped from property near Sells by the Ninety-Nine Mining Co.

Cerro Colorado District.—Operations were carried on throughout the year at the Mary G. mine, and 42 tons of silver-lead ore were shipped to the smelter at El Paso.

Empire District.—A lessee worked the Empire (Hilton) mine in 1946 and shipped 306 tons of lead ore to El Paso. A small lot of copper ore was produced from the Esperanza claim.

Greaterville District.—The St. Louis Mines, Inc., operated the St. Louis mine in 1946 and hauled 110 tons of zinc-lead ore to the Eagle-Picher flotation mill near Sahuarita.

Helvetia (Rosemont) District.—Six mines in the Helvetia district produced a total of 44,577 tons of ore in 1946; all but 118 tons was copper ore. The Blankenship family operated the Helvetia group continuously, shipped 32,268 tons of copper ore to smelters in Arizona and Texas, and hauled 393 tons of similar ore to the Eagle-Picher mill. Other producers of copper ore included the Mohawk (8,308 tons), Newman (1,818 tons), Daylight (939 tons), and Rosemont (693 tons) properties. In addition to copper ore, the Daylight mine produced 118 tons of zinc-copper ore, which was treated in the Eagle-Picher mill.

Old Hat District (Oracle).—Control Mines Co. operated the Geeseman mine until May 1, 1946, when it was abandoned and allowed to fill with water. During the first 4 months of the year the company

treated 700 tons of copper ore in its 100-ton flotation mill and shipped 516 tons of similar ore to the copper smelter at Hayden; the mill was dismantled in June. Copper ore (106 tons) was produced also from a claim operated by Newton Wells.

Pima (Sierritas, Papago, Twin Buttes) District.—The most important operation of a zinc-lead mine in Pima County in 1946 was at the San Xavier property near Sahuarita by the Eagle-Picher Mining & Smelting Co. The company 400-ton flotation mill treated 69,007 tons of ore during the year. Of this total, 46,108 tons, averaging 3.22 ounces of silver to the ton, 0.76 percent copper, 6.035 percent lead, and 10.794 percent zinc came from the San Xavier group, and the remainder—22,899 tons—comprised various classes of ore received from custom shippers. The mill yielded 4,775 tons of lead concentrate, 10,855 tons of zinc concentrate, and 755 tons of lead-copper concentrate. The rest of the district output comprised 3,287 tons of zinc-copper ore produced from the Contention mine and treated in the Eagle-Picher mill, 204 tons of silver-lead ore from the Sunshine mine, and 200 tons of gold-silver ore from the Whitcomb property.

Roskruge and Waterman (Silver Hill) District.—Copper-silver ore was mined most of the year at the old Silver Hill mine by the Arizona Copper Bell Mining Co.; the company shipped 2,625 tons of crude ore to smelters in Arizona and Texas.

Silver Bell District.—The Indiana-Arizona Mining Co. operated under lease the Arizona-Indiana mine in 1946 and shipped 106 tons of silver-lead ore and 55 tons of copper ore to El Paso, Tex.

PINAL COUNTY

Martinez Canyon District.—Approximately 574 tons of lead ore were produced in 1946 from the Silver Bell-Martinez group by the California Steel Products Co.; 522 tons were treated in the company 50-ton gravity-concentration mill, and 52 tons were shipped direct to a smelter.

Mineral Creek District (Ray).—Mining of copper ore at the Ray property of the Kennecott Copper Corp. was continuous throughout the year but at a lower rate than in 1945; in 1946 the output was 1,300,758 tons compared with 1,366,473 tons in 1945. The crude ore, averaging 1.238 percent copper (1.277 percent in 1945), was hauled by rail 26 miles to the company 10,000-ton flotation mill at Hayden, where it was reduced to 49,268 tons of concentrate averaging 25.724 percent copper; the concentrate was smelted in the American Smelting & Refining Co. plant, also at Hayden. In addition, 4,241 tons of copper precipitates were shipped to the Kennecott Copper Corp. smelter at Hurley, N. Mex. Nearly all the rest of the district output was oxide copper ore (14,034 tons) produced from an open pit at the Copper Butte property and shipped to the smelter at Hayden.

Mineral Hill District.—Leasing operations at the Silver Pick mine produced 24 tons of silver ore in 1946.

Old Hat District (Oracle).—The name of the company operating the Mammoth-St. Anthony property at Tiger was changed in 1946 from Mammoth-St. Anthony, Ltd., to St. Anthony Mining & Development Co., Ltd. The property, one of the most important producers of zinc-lead ore in Arizona, was operated continuously in 1946; 86,049

tons of ore, averaging 0.007 ounce of gold and 1.14 ounces of silver to the ton, 0.45 percent copper, 6.10 percent lead, and 7.48 percent zinc, were treated in the company 350-ton concentration mill. The lead concentrate (7,211 tons) and the zinc concentrate (8,720 tons) were shipped to smelters in Texas. The property ranked second in production of lead in Arizona in 1946 and third in zinc. A small lot of high-grade lead ore was produced from a prospect south of Oracle. No ore was produced in 1946 from the San Manuel property, south of Tiger, owned by the Magma Copper Co.; but, according to the company annual report for 1946, active drilling continued throughout the year which greatly increased the proved tonnage of copper ore to a total of 211,500,000. It is believed that 127,500,000 tons of this total can be treated by ordinary sulfide flotation, but the balance of about 84,000,000 tons must be treated by some method suitable to oxidized material. The major drilling campaign is almost completed, and there is now sufficient tonnage of ore to support the large-scale production necessary for the successful operation of the property. Much capital and considerable time will be necessary to bring the property into production. Plans for financing the next step in the development of this project are now under consideration.

Pioneer District (Superior).—The Magma mine, one of the most important producers of gold, silver, and copper (no zinc produced in 1946) in Arizona, was operated continuously in 1946 and at a greater rate than in 1945. During the year 176,063 tons of copper ore were treated in the company 850-ton concentrator, and 24,753 tons of crude copper ore and 42,273 tons of copper concentrate were sent to the company 450-ton smelter at Superior; the concentrates averaged 0.144 ounce of gold and 4.464 ounces of silver to the ton and 25.764 percent copper. No zinc concentrate was produced in 1946.

According to the company annual report for 1946, the net metal produced from Magma ore and concentrates comprised 7,549 ounces, of gold, 241,951 ounces of silver, and 23,581,845 pounds of copper. The average net cost of producing copper after gold and silver values were deducted was 15.69 cents a pound in 1946 compared with 13.70 cents in 1945. The increased cost resulted largely from a much higher wage scale, which became effective late in 1945 and early in 1946. The labor supply has improved considerably compared with 1945, but 300 additional men are needed to fulfill present requirements for full production and development. Because of this shortage, production is currently approximately 60 percent of normal. Most of the ore mined in 1946 came from the 3,800, 4,000, and 4,200 levels in the west block. Stoping was resumed on the 3,200 level in the east block, and some ore was mined on the 4,400 level, where stopes in the west block were being reopened. Development during the year comprised 1,784 feet of raising, 1,507 feet of drifting, and 285 feet of crosscutting. The progress in constructing the new mill has been disappointingly slow. The crushing plant should be completed by June; and the mill should be completed by September 1947, contingent on delivery of equipment.

The remainder of the district output was principally 894 tons of siliceous silver ore produced from the Reymert and Picket Post properties and shipped to the Magma smelter.

Summit District.—Lessees operated the American mine a few months in 1946 and shipped 84 tons of copper ore to the Magma smelter.

SANTA CRUZ COUNTY

Harshaw District.—Output of ore in the Harshaw district in 1946 was much smaller than in 1945, owing to a marked decline in production of zinc-lead-silver ore caused by a labor strike from February 25 to June 20 at the Trench-Flux-January groups operated by the American Smelting & Refining Co. The company reported that 25,080 tons of zinc-lead-silver ore were produced in 1946 compared with 44,437 tons in 1945. This tonnage, along with 3,066 tons of zinc-lead-copper ore received from an operator in the Patagonia district was treated in the company 200-ton flotation mill. The rest of the district output was 147 tons of oxide lead ore shipped direct to a smelter from the Hardshell mine by the American Smelting & Refining Co.

Oro Blanco District (Ruby).—Hugo W. Miller worked the Montana mine continuously in 1946, hauled 410 tons of zinc-lead ore to the Eagle-Picher mill near Sahuarita, and shipped 156 tons of silver-lead ore to the smelter at El Paso. About 75 tons of gold ore from the Oro Blanco property were treated in an amalgamation mill.

Palmetto District.—Output of ore in the Palmetto district dropped from 5,251 tons in 1945 to 640 tons in 1946, as the Three "R" mine, the only producer in the district, was operated only 2 months in 1946; all the output was copper ore shipped to a smelter.

Patagonia (Duquesne) District.—A. R. Byrd, Jr., operated the Duquesne and Pride of the West properties continuously in 1946; hauled 12,295 tons of ore, containing an average of 3.71 ounces of silver to the ton and 1.91 percent copper, 4.11 percent lead, and 9.10 percent zinc, to the Eagle-Picher and Trench flotation mills; and shipped 367 tons of lead ore and copper ore to smelters at El Paso. The remainder of the district output was 631 tons of copper ore shipped to smelters from the Arizona, Buena Vista, and Roy mines.

Tyndall District.—Lessees continued to work the Jefferson mine, hauled 1,268 tons of zinc-lead ore to the Eagle-Picher mill, and shipped 44 tons of lead ore to a smelter. The rest of the district output was 320 tons of copper ore produced from the Royal Blue mine and 60 tons of zinc-lead ore and 39 tons of copper ore from the Bland claim.

YAVAPAI COUNTY

Agua Fria District.—All the output in the Agua Fria district continued to be high-silica copper ore shipped direct to smelters; 5,565 tons were produced in 1946 from the Stoddard mine, 3,724 tons from the Binghampton mine 6 miles east of Mayer, and 375 tons from the Yaller Kid claim.

Big Bug District.—In 1946 the Big Bug district ranked second in gold and zinc production in the State and fourth in silver and lead production. The Iron King mine of the Shattuck Denn Mining Corp. was the principal producer; it was operated continuously throughout the year, and 115,613 tons of ore averaging 0.113 ounce of gold and 4.04 ounces of silver to the ton and 0.213 percent copper, 2.49 percent lead, 7.30 percent zinc, and 22.00 percent iron were

treated in the company 375-ton flotation mill. The mill treated a total of 117,343 tons of ore (including 1,730 tons of custom ores) in 1946, which yielded 8,959 tons of lead concentrate, 12,547 tons of zinc concentrate, and 4,848 tons of iron concentrate. According to the annual report of the Shattuck Denn Mining Corp. for 1946, production of lead, zinc, and other metals from the Iron King mine was higher than in any preceding year. Additions and improvements are now being installed at the mill, which will increase its capacity by 30 percent. The rest of the district lode output was mainly 3,395 tons of copper ore shipped to a smelter from the Blue Bell mine. The placer output was 75 ounces of gold and 10 ounces of silver; most of it was recovered by a dragline dredge at the Nelson & Fitch property near Mayer.

Black Canyon District.—A total of 83 tons of ore was produced in 1946 from three mines in the Black Canyon district, and 2 ounces of placer gold were recovered from a claim near Cordes. Zinc ore (42 tons) was produced from the French Lilly mine, gold ore (34 tons) from the Golden Turkey mine, and high-grade silver ore (7 tons) from the Thunderbolt mine.

Blue Tank (Hassayampa River) District.—About 12 ounces of placer gold were recovered in 1946 by sluicing at claims along the Hassayampa River, 8 miles north of Wickenburg.

Castle Creek District.—Small lots of copper ore containing gold and silver were produced from two claims in the Castle Creek district in 1946, and 4 ounces of placer gold were recovered from the Buckhorn property.

Cherry Creek District.—The output of the Cherry Creek district in 1946 was all gold ore (17 tons) produced from the Gold Pick No. 1 claim.

Copper Basin District.—Fred D. Schemmer operated the Commercial mine continuously in 1946 and shipped 9,070 tons of high-silica copper ore to the smelter at Clarkdale. W. B. Tenney, lessee of the Boston-Arizona mine, hauled 1,411 tons of zinc ore to the Iron King flotation mill at Humboldt for treatment.

Eureka District (Bagdad).—Mining and milling copper ore from the Bagdad mine of the Bagdad Copper Corp. were continuous throughout the year and at a greater rate than in 1945. The company reported that 862,535 tons of ore, averaging 1.00 percent copper were treated in 1946 in its 3,000-ton flotation mill and that 17,095 tons of copper concentrate were shipped to the smelter at El Paso. During the year the company began constructing a leach-float plant, and a conveyor was being erected to haul ore from the pit to the mill. The remainder of the district lode output was principally 667 tons of zinc oxide ore and 372 tons of zinc-lead sulfide ore shipped to various reduction works in Arizona and Utah from the Copper King mine, 532 tons of zinc-lead ore produced from the Ethiopia mine, and 143 tons of gold-silver ore shipped to a smelter from the Hillside mine. Placer gold, amounting to 7 fine ounces, was recovered from Burro Creek and Santa Maria River.

Hassayampa (Groom Creek, Hassayampa River, Senator, Prescott) District.—More activity at both lode and placer properties in the Hassayampa district in 1946 resulted in a greater metal output than in 1945. The principal lode output was 324 tons of gold ore produced

from the Gold Charm mine and 244 tons of zinc-lead-gold ore from the Sun Dance mine. The placer output was 194 fine ounces of gold and 47 fine ounces of silver; nearly all of it was recovered by a dragline dredge at the Hobbs property on the Hassayampa River.

Lynx Creek District.—The output of the Lynx Creek district in 1946 was all placer gold and silver recovered by a special land washing plant at the Fitzmaurice property.

Martinez (Congress) District.—The 300-ton cyanide mill at the Congress property, idle since May 1, 1942, on account of the war, was operated continuously from August 1, 1946, to the end of the year by the Congress Metals, Inc. Approximately 22,000 tons of waste dump ore and old tailings were treated, which yielded 857 fine ounces of gold and 2,812 fine ounces of silver. The remainder of the district output was 2 tons of gold ore produced from the Gold Key claim.

Pine Grove District (Crown King).—The value of the metal output in the Pine Grove district was much greater in 1946 than in 1945, owing to an increase in output of zinc-lead-gold-silver ore from the Gladiator-War Eagle group and to new production of zinc ore and gold ore from the Crown King-Wildflower group. About 6,000 tons of ore from the Gladiator-War Eagle group were treated by flotation and gravity concentration, which yielded 296 tons of lead concentrate containing considerable gold and 272 tons of zinc concentrate. The Golden Crown Mining Co. operated the Crown King-Wildflower group all year; treated 2,600 tons of ore, averaging 0.03 ounce of gold and 2.62 ounces of silver to the ton and 0.65 percent copper and 5.34 percent zinc, in its 75-ton flotation mill; and shipped 70 tons of gold ore direct to a smelter. The rest of the district output was mainly 148 tons of copper ore produced from the Springfield mine and 49 tons of lead ore from the Del Pasco mine.

Silver Mountain District.—Some low-grade gold ore (34 tons) was shipped in 1946 from the Fenton No. 1 claim, and small lots of lead ore were produced from the Colossal property.

Squaw Peak District.—In 1946, as in 1945, all the output in the Squaw Peak district was copper-molybdenum ore produced from the Squaw Peak mine; 378 tons of ore were treated in a 25-ton flotation mill, which yielded 16 tons of copper concentrate and 2 tons of molybdenum concentrate.

Turkey Creek District.—Jack Shull operated the Old Soldier mine in 1946, and shipped 15 tons of gold-silver-copper ore to the smelter at Clarkdale.

Verde District (Jerome).—Contrary to some of the large copper producers in Arizona, operations at the United Verde mine in 1946, were not affected by a labor strike; however, the output of copper ore continued to decline from 377,217 tons in 1945 to 336,745 tons in 1946. Of the ore mined in 1946, from the property by the Phelps Dodge Corp., 161,166 tons were siliceous-copper ore shipped to the corporation smelter at Clarkdale, and 175,579 tons were similar ore treated in the corporation's 2,100-ton concentrator. In addition, 204 tons of copper precipitates were shipped to the smelter.

According to the annual report of the corporation for 1946, progressive depletion of the remaining copper ore reserves and accompanying restriction in stoping areas resulted in a further decline in the rate of

production. Present indications are that the copper-ore reserves will be exhausted within 2 or 3 years unless in the meantime additional ore should be discovered. Exploratory work by drifting and diamond drilling was continued on the lower levels contiguous to No. 8 shaft; however, no mineralized areas of importance were discovered. During the year a total of 18,323 feet of prospecting and development was completed, comprising 1,819 feet of drifting, 766 feet of raising, and 15,738 feet of diamond drilling.

The remainder of the district output was 13,720 tons of siliceous-copper ore shipped to the smelter at Clarkdale from the Dundee-Arizona, Florentia, and Verde properties.

Walker District.—Most of the output in the Walker district in 1946, was gold ore (110 tons) produced from the Champion, Gold Coin, Oro Plata, St. Elmo, and Sheldon properties, and zinc-lead ore (49 tons) from the Lost Wonder and New Strike mines.

Walnut Grove (Hassayampa River) District.—About 7 ounces of placer gold were recovered in 1946, by sluicing gravel along the Hassayampa River near Walnut Grove.

Weaver District (Octave).—The output of the Weaver district in 1946 was 448 tons of gold ore shipped to smelters from the Gold Bug, Lost Dutchman, Helen Morris, Octave, Rincon, and Surprise properties and 6 ounces of placer gold recovered from gravel at Rich Hill and from Antelope Creek. Nearly 79 percent of the gold ore was produced by lessees operating the Octave mine.

White Picacho District.—Gold ore (32 tons) was shipped in 1946 from the Bullfrog mine, and small lots of silver ore, silver-lead ore, and copper ore were produced from various claims and sold to the Wickenburg ore market.

YUMA COUNTY

Castle Dome District.—The Joplin Lead Co. took over the De Luce and Rialto groups in 1946, rehabilitated the 300-ton gravity concentration mill at McPhaul bridge on the Gila river, treated about 2,000 tons of oxide lead ore in the mill, and shipped 19 tons of crude lead ore to the smelter at El Paso. The lead concentrate (148 tons) contained 2,794 ounces of silver, 151,545 pounds of lead, and a little zinc.

Ellsworth (Harqua Hala) District.—The Yuma Copper mine near Vicksburg was operated a few months in 1946 by the Liberator Mines Co.; 1,131 tons of ore, containing 55 ounces of gold, 309 ounces of silver, and 62,338 pounds of copper, were shipped to the Magma smelter at Superior. The rest of the district output was nearly all gold-copper ore (190 tons) produced from the Quail Nest mine near Aguila.

Plomosa District—Both lode and placer properties were operated in 1946 in the Plomosa district. The lode output comprised 1,014 tons of silver ore shipped to a smelter by lessees working the R. & A. mine; 66 tons of gold ore shipped from the Little Butte mine; and 1 ton of ore amalgamated by the Mohave Mining Co., which yielded 173 fine ounces of gold and 23 fine ounces of silver. The placer output (17 fine ounces of gold) was recovered principally by drift mining at the Big Wash Basin and Mackey properties.

California

Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By ALFRED L. RANSOME

	PAGE		PAGE
General summary	1336	Mining industry	1347
Calculation of value of metal production	1337	Ore classification	1348
Mine production by counties	1345	Metallurgic industry	1352
		Review by counties and districts	

GENERAL SUMMARY

CALIFORNIA lead production in 1946 was one-third greater than in 1945—only 9 percent below the record output of 1917—and the value was the largest in the history of mining in the State. Gold production was nearly two and one-half times that for 1945, but far below the prewar level (1,408,793 fine ounces in 1941). Silver production was 36 percent higher than in 1945, making 1946 the third successive year of increase, whereas copper and zinc production dropped about one-third below the 1945 output. The total value of the five metals was $18,788,664, an increase of 68 percent above 1945. The upward trend in gold output was largely the result of increased placer-mining activity. The increased prices of silver, copper, lead and zinc might have been expected to result in a greater output of these metals. Although this was apparently true for silver and lead, the rise in production of silver and lead and the lower output of copper and zinc largely resulted from the activity of a few mines and did not reflect the general upswing in the industry evidenced by the increase in the number of mines in operation. In 1946, 150 lode mines and 172 placer mines were active compared with 87 and 99, respectively, in 1945.

Comparing 1946 with 1945, gold increased 141 percent in quantity and value; silver advanced 36 percent in quantity and 55 percent in value; copper decreased 34 percent in quantity and 21 percent in value; lead increased 37 percent in quantity and 74 percent in value; and zinc was 31 percent lower in quantity and 26 percent in value. Of the total value of the five metals in 1946, gold represented 66, lead 12, zinc 9, copper 7, and silver 6 percent.

As the result of large-scale gold dredging in 1946, Sacramento County was the largest contributor to metal-mining output in California, an advance from fourth place in 1945; it supplied 19 percent of the State total value of the five metals. Inyo County yielded the first place which it held in 1945 but ranked second by a close margin, owing to lead production, which represented nearly two-thirds of the total value of its metal output; the greater portion of

lead, as well as substantial quantities of silver, copper, and zinc, came from the Darwin group of mines, Coso district. Inyo County contributed 17 percent of the total value of the five metals. Yuba County (almost entirely from gold dredging) supplied 11 percent of the total value of the five metals; Nevada County (largely from gold ore), 10 percent; Shasta County (largely from zinc-copper ore), 9 percent; Calaveras County (from zinc and copper ores and old tailings, gold ore, and gravels), 8 percent; Stanislaus and Butte Counties (largely from gold dredging), 5 and 4 percent, respectively; and San Bernardino (from zinc, lead, and gold ores, and gravels) and Trinity (largely from placer gravels), 3 percent each. Of the 32 counties producing the 5 metals in California in 1946, the first 6 of the foregoing 10 counties each contributed over 1 million dollars worth; together the 10 counties supplied 88 percent of the total value of these metals.

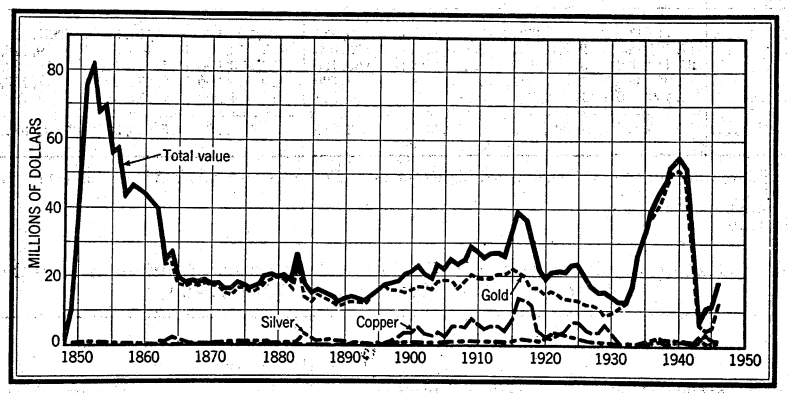

FIGURE 1.—Value of mine production of gold, silver, and copper and total value of gold, silver, copper, lead, and zinc in California, 1848–1946. The value of lead and zinc has exceeded $1,000,000 in only a few years.

All tonnage figures are short tons and "dry weight"; that is, they do not contain moisture.

Yardage figures used in measuring material treated in placer operations are "bank measure"; that is, the material is measured in the ground before treatment.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1942–46

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per ounce fine	*Per ounce fine*	*Per pound*	*Per pound*	*Per pound*
1942	$35.00	$0.711+	$0.121	$0.067	$0.093
1943	35.00	.711+	.130	.075	.108
1944	35.00	.711+	.135	.080	.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+($20.671835) per fine ounce.

[2] Treasury buying price for newly mined silver. 1942 to June 30, 1946: $0.71111111; July 1, to Dec. 31, 1946: $0.905.

[3] Yearly average weighted price of all grades of primary metal sold by producers; price includes bonus payments by Office of Metals Reserve for overquota production.

Mine production of gold, silver, copper, lead, and zinc in California, 1942–46, and total, 1848–1946, in terms of recovered metals

Year	Mines producing [1]		Ore, old tailings, etc. (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1942	434	428	2,503,198	847,997	$29,679,895	1,450,440	$1,031,424
1943	139	82	739,956	148,328	5,191,480	609,075	433,120
1944	109	66	925,953	117,373	4,108,055	778,936	553,910
1945	87	99	717,969	147,938	5,177,830	986,798	701,723
1946	150	172	627,767	356,824	12,488,840	1,342,651	1,084,862
1848–1946			[2]	101,881,219	2,267,946,317	108,200,088	87,140,942

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1942	2,116,000	$256,036	10,302,000	$690,234	1,226,000	$114,018	$31,771,607
1943	17,524,000	2,278,120	11,640,000	873,000	3,712,000	400,896	9,176,616
1944	25,442,000	3,434,670	11,364,000	909,120	16,910,000	1,927,740	10,933,495
1945	12,946,000	1,747,710	14,448,000	1,242,528	19,846,000	2,282,290	11,152,081
1946	8,480,000	1,373,760	19,846,000	2,163,214	13,754,000	1,677,988	18,788,664
1848–1946	[3] 625,824	201,293,864	[3] 159,652	20,643,017	[3] 80,207	15,858,396	2,592,882,536

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Figure not available.
[3] Short tons.

Gold production at placer mines in California, by classes of mines and methods of recovery, 1942–46, and total, 1848–1946 [1]

Class and method	Mines producing [2]	Washing plants (dredges)	Material treated (cubic yards)	Gold recovered		
				Fine ounces	Value	Average value per cubic yard
Surface placers:						
Gravel mechanically handled:						
Connected-bucket dredges:						
1942	30	44	106,543,000	310,937	$10,882,795	$0.102
1943	8	10	17,880,000	66,999	2,344,965	.131
1944	5	7	21,524,000	64,925	2,272,375	.106
1945	16	26	30,738,000	88,318	3,091,130	.101
1946	22	32	78,175,000	244,679	8,563,765	.110
Dragline dredges:						
1942	122	79	24,526,000	117,906	4,126,710	.168
1943	3	3	3,180,000	14,196	496,860	.156
1944	2	2	1,213,000	6,241	218,435	.180
1945	6	6	414,400	1,242	43,470	.105
1946	39	38	4,309,000	16,932	592,620	.138
Becker-Hopkins dredges:						
1942	1	----	5,000	23	805	.161
1943–46	----	----	----	----	----	----
Suction dredges: [3]						
1942	18	15	278,000	1,419	49,665	.179
1943–45	----	----	----	----	----	----
1946	1	1	22,900	112	3,920	.171

See footnotes at end of table.

Gold production at placer mines in California, by classes of mines and methods of recovery, 1942–46, and total, 1848–1946 [1]—Continued

Class and method	Mines producing [2]	Washing plants (dredges)	Material treated (cubic yards)	Gold recovered		
				Fine ounces	Value	Average value per cubic yard
Surface placers—Continued						
Gravel mechanically handled—Continued						
Nonfloating washing plants: [4]						
1942	46	40	1,637,000	10,044	$351,540	$0.215
1943	16	15	547,000	2,997	104,895	.192
1944	14	14	223,000	1,210	42,350	.190
1945	8	8	519,300	974	34,090	.066
1946	13	13	771,000	2,576	90,160	.117
Gravel hydraulically handled:						
Hydraulic:						
1942	45	----------	1,980,000	6,106	213,710	.108
1943	12	----------	366,000	1,723	60,305	.165
1944	13	----------	212,000	838	29,330	.138
1945	17	----------	282,300	922	32,270	.114
1946	17	----------	443,300	1,147	40,145	.091
Small-scale hand methods: [5]						
Wet:						
1942	119	----------	1,152,900	16,079	562,765	.488
1943	29	----------	118,460	2,536	88,760	.749
1944	25	----------	96,000	1,408	49,280	.513
1945	45	----------	88,300	1,526	53,410	.605
1946	72	----------	624,000	4,165	145,775	.234
Dry:						
1942	7	----------	1,100	73	2,555	2.323
1943	1	----------	40	4	140	3.500
1944	(6)	----------	200	3	105	.525
1945	----------	----------	----------	----------	----------	----------
1946	1	----------	100	3	105	1.050
Underground placers:						
Drift:						
1942	45	----------	22,000	2,339	81,865	3.721
1943	13	----------	4,500	970	33,950	7.544
1944	7	----------	3,800	424	14,840	3.905
1945	7	----------	2,700	498	17,430	6.456
1946	7	----------	5,700	158	5,530	.970
Grand total placers:						
1942	[7] 428	----------	136,145,000	464,926	16,272,410	.120
1943	82	----------	22,096,000	89,425	3,129,875	.142
1944	66	----------	23,272,000	75,049	2,626,715	.113
1945	99	----------	32,045,000	93,480	3,271,800	.102
1946	172	----------	84,351,000	269,772	9,442,020	.112
1848–1946 [1]	----------	----------	(8)	65,532,794	1,429,385,436	(8)

[1] For historic data by years see Minerals Yearbook, Review of 1940, p. 219.
[2] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[3] Includes all placer operations using suction pump for delivering gravel to floating washing plant except those producing less than 100 ounces of gold which are included under "Small-scale hand methods."
[4] Includes all placer operations using power excavator and washing plant, both on dry land; when washing plant is movable, outfit is termed "dry-land dredge."
[5] Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long toms, dip boxes, pans, rockers, dry washers, etc.
[6] From property not classed as a "mine."
[7] A mine using more than 1 method of recovery is counted but once in arriving at total for all methods.
[8] Complete data not available.

Gold.—Production of 356,824 ounces of gold in California in 1946 was nearly 2½ times the output in 1945. Although 1946 was the second year of increase from the low point of 117,373 ounces in 1944 under War Production Board Limitation Order L–208, the value of the output ($12,488,840) was only 25 percent of the $50,948,485 in gold produced in 1940, the largest value since 1856. The marked increase in the production of gold since the rescinding of Order L–208, effective July 1, 1945, was due largely to the rapid acceleration in placer mining, principally by connected-bucket dredging. The rate of increase in production would have been even greater had lode gold mining been reestablished with equal rapidity. With the exception of a few properties, many of the lode mines that were large producers before the war had not reopened, and one famous producer—the Empire Star Mines Co., Ltd., in the Grass Valley district, Nevada County—suspended operation of its Empire Star group of mines July 1, 1946. The principal reasons for this shut-down, as well as the failure of so many other properties to reopen at all, were the fixed price for gold and the over-all inflationary trend that affected costs of labor, supplies, and equipment.

Monthly production of gold in 1946 gained rapidly during the first 3 months to continue the upward swing that began in September 1945. From March through July the monthly output remained relatively unchanged at about 29,700 ounces. Following a rise to 34,340 ounces in August, the monthly rate of production again leveled for the balance of the year. The monthly average for the year was 29,735 ounces compared with 12,328 ounces for 1945 and 9,781 ounces for 1944. Monthly production figures since January 1937 through the war years have been discussed in detail in this chapter for 1944 and 1945.

The 25 leading gold-producing mines in California in 1946, listed in the accompanying table, yielded 88 percent of the total gold output of the State; the leading 5 mines produced 56 percent and the leading 10 mines, 70 percent.

Twenty-five leading gold-producing mines in California in 1946, in order of output

Rank	Mine	District	County	Rank in 1945	Operator	Source of gold
1	Natomas Co	Folsom	Sacramento	2	Natomas Co	Dredge.
2	Yuba unit	Yuba River	Yuba	1	Yuba Consolidated Gold Fields	Do.
3	Idaho Maryland and Brunswick	Grass Valley-Nevada City	Nevada	3	Idaho Maryland Mines Corp	Gold ore.
4	Tuolumne gold dredge	La Grange	Stanislaus	6	Tuolumne Gold Dredging Corp	Dredge.
5	Capital dredge	Folsom	Sacramento	9	Capital Dredging Co	Do.
6	Upper and Lower Comanche dredge	Camanche	San Joaquin	5	Gold Hill Dredging Co	Do.
7	Junction City	Junction City	Trinity	21	Junction City Mining Co	Do.
8	Butte unit	Oroville	Butte	15	Yuba Consolidated Gold Fields	Do.
9	La Grange dredge No. 4	La Grange	Stanislaus	11	La Grange Gold Dredging Co	Do.
10	Original Sixteen to One	Alleghany	Sierra	8	Original Sixteen to One Mine, Inc	Gold ore.
11	Empire Star group	Grass Valley-Nevada City	Nevada	4	Empire Star Mines Co. Ltd	Do.
12	Lancha Plana dredge No. 4	Folsom	Sacramento	25	Lancha Plana Gold Dredging Co	Dredge.
13	Thurman dredge	Redding	Shasta	18	Thurman Gold Dredging Co	Do.
14	Kister	Oroville	Butte	14	Gold Hill Dredging Co	Do.
15	Thurman & Wright	Cosumnes River	Sacramento	(1)	Thurmar & Wright	Do.
16	Ancho and Erie groups	Washington	Nevada	12	Ancho-Erie Mining Co	Gold ore.
17	Clear Creek	French Gulch	Shasta	13	French Gulch Dredging Co	Dredge.
18	Lancha Plana dredge No. 5	Butte Creek	Butte	(1)	Lancha Plana Gold Dredging Co	Gold ore.
19	Penn	Campo Seco	Calaveras	10	Shawmut Copper Mine Co	Zinc ore.
20	Mount Gaines	Hunter Valley	Mariposa	20	Mount Gaines Mining Co	Gold ore.
21	Yreka gold dredge	Klamath River	Siskiyou	24	Yreka Gold Dredging Co	Dredge.
22	Scandia Nos. 1-2-3	do	do	(1)	Larsen and Harms	Do.
23	Brush Creek	Downieville	Sierra	19	Alfred L. Merritt	Gold ore.
24	Merced dredge No. 1	Snelling	Merced	17	Merced Dredging Co	Dredge.
25	Siskiyou unit	Callahan	Siskiyou	23	Yuba Consolidated Gold Fields	Do.

1 Not operated in 1945.

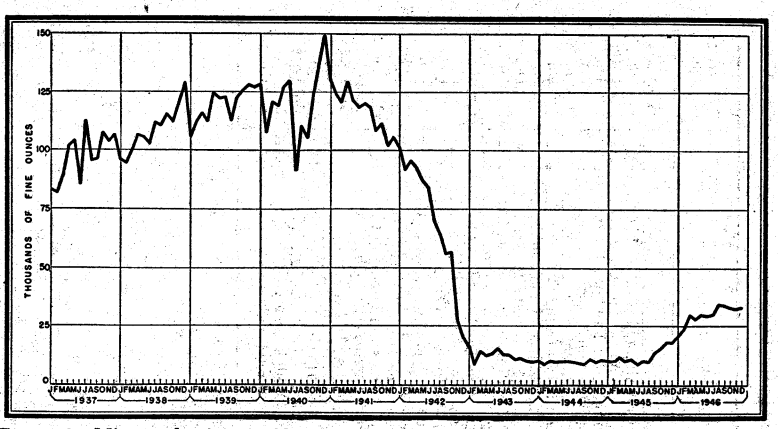

FIGURE 2.—Mine production of gold in California, 1937–46, by months, in terms of recovered gold.

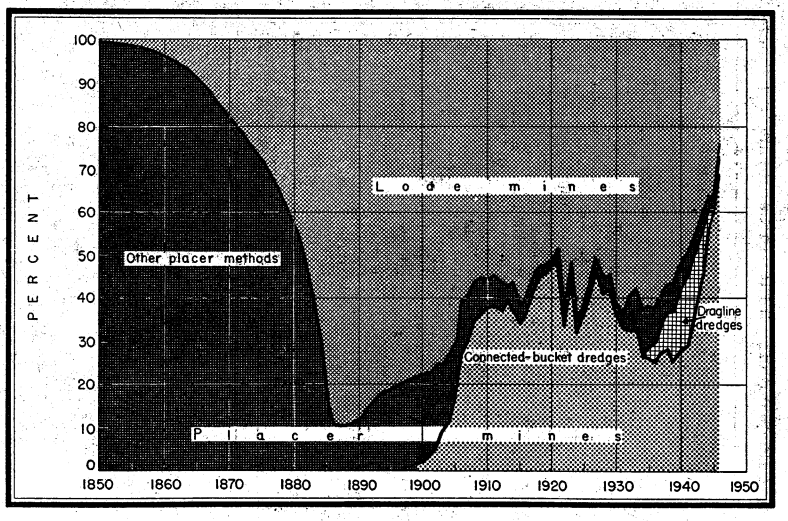

FIGURE 3.—Percentage of total California gold produced at lode and placer mines and by various methods of placer mining, 1850–1946.

Silver.—The 10 leading silver-producing mines listed in the accompanying table yielded 95 percent of the State total recoverable silver in 1946; the 3 leading mines yielded 80 percent. Of the 10 leading silver-producing mines, 8 derived their silver from argentiferous base-metal ores, 1 from gold-silver ore, and 1 from tungsten ore.

Silver production by months in 1946, as presented in the accompanying table, shows a sharp drop in February, followed by a period of moderate fluctuation through August at an average level of 83,300 ounces. Output in September increased markedly to 132,450 ounces, followed by a continuing advance during the last quarter that showed indications of leveling by the end of the year. The entire background for the trend in production is closely allied to the operation of the Darwin group of mines, Coso district, Inyo County, operated by the Anaconda Copper Mining Co.

Ten leading silver-producing mines in California in 1946, in order of output

Rank	Mine	District	County	Rank in 1945	Operator	Source of silver
1	Darwin group	Coso	Inyo	1	Anaconda Copper Mining Co	Lead ore.
2	Penn	Campo Seco	Calaveras	4	Shawmut Copper Mine Co	Zinc ore.
3	Hornet	Flat Creek	Shasta	3	The Mountain Copper Co., Ltd	Zinc-copper ore.
4	Columbia No. 2	Resting Springs	Inyo	5	Finley Co	Lead ore.
5	Kelly and Juanita	Randsburg	San Bernardino	(1)	F. W. Royer	Gold-silver ore.
6	Carbonate King	Clark Mountain	do	(1)	Crystal Cave Mining Co	Zinc ore.
7	Mohawk	do	do	7	Dunton-Ray & Greenwood	Lead and lead-zinc ore.
8	Modoc	Coso	Inyo	6	L. D. Foreman & Co	Lead ore.
9	Pine Creek	Bishop Creek	do	(1)	U. S. Vanadium Corp	Tungsten ore.
10	Newton	Ione	Amador	9	Pacific Mining Co	Copper ore.

[1] Not operated in 1945.

Mine production of gold, silver, copper, lead, and zinc by months in 1946, in terms of recovered metals

Month	Gold (Fine ounces)	Silver (Fine ounces)	Copper (Short tons)	Lead (Short tons)	Zinc (Short tons)
January	20,604	127,544	508	1,084	736
February	23,576	74,565	390	690	508
March	29,727	90,262	456	927	547
April	28,189	89,772	521	937	745
May	29,727	77,508	456	730	697
June	29,214	78,489	430	690	692
July	29,727	82,413	352	740	542
August	34,340	81,432	261	690	513
September	33,827	132,450	228	719	445
October	32,802	156,978	248	818	484
November	32,289	174,638	195	937	484
December	32,802	176,600	195	961	484
Total	356,824	1,342,651	4,240	9,923	6,877

Copper.—Copper production in California in 1946 dropped 34 percent below that for 1945, owing largely to the inactivity of two mines that had been large wartime producers and had produced during the first half of 1945 (Dakin or Gray Eagle mine, Klamath River district, Siskiyou County, and the Keystone mine, Copperopolis district, Calaveras County). The monthly copper-production figures given in the accompanying table show only the approximate trend in production during 1946. Because of the strike at copper smelters during the first half of 1946 much of the copper ore and copper concentrate was stock-piled at mines, and some properties were forced to curtail production or close. In general, production was erratic, but the over-all trend was downward throughout the year. The following six properties (operators in parentheses), listed in order of output and each producing over 100,000 pounds, supplied 98 percent of the State total, and the first three 91 percent: Hornet mine, Flat Creek district, Shasta County (The Mountain Copper Co., Ltd.); Newton mine, Ione district, Amador County (Pacific Mining Co.); Penn mine, Campo Seco district, Calaveras County (Shawmut Copper Mine Co.); Pine Creek Tungsten mine, Bishop Creek district, Inyo County (U. S. Vanadium Corp.); Union mine (old tailings), Copperopolis district, Calaveras County (Pacific Mining Co.); and the Darwin group, Coso district, Inyo County (Anaconda Copper Mining Co.).

Lead.—The expansion of lead production from 990,000 pounds in 1938 to 19,846,000 pounds in 1946 (within 9 percent of the all-time record of 21,868,628 pounds in 1917) resulted in lead displacing copper as the second most valuable of the five metals produced in the State (in 1942 lead displaced copper as the third most valuable metal); output of lead was 37 percent above 1945. The monthly lead-production figures given in the accompanying table follow a trend which closely parallels that for silver and is allied to operation of the Darwin group of mines, Coso district, Inyo County. The three leading producers of lead accounted for 93 percent of the State total in 1946. The following six properties (operators in parentheses), listed in order of lead output and each producing over 100,000 pounds, furnished 98 percent of the State total: The Darwin group, Coso district, Inyo County (Anaconda Copper Mining Co.); Columbia No. 2 mine, Resting Springs district, Inyo County (Finley Co.);

Mohawk mine, Clark Mountain district, San Bernardino County (Emerson A. Ray et al.); Modoc mine, Modoc district, Inyo County (L. D. Foreman & Co.); Penn mine, Campo Seco district, Calaveras County (Shawmut Copper Mine Co.); and Gold Bottom & Ophir mines, Slate Range district, Inyo County (Damon & Damon).

Zinc.—Zinc production in California in 1946 showed a marked drop of 31 percent from 1945, owing largely to the shut-down of the Blue Moon mine, Hunter Valley district, Mariposa County, November 15, 1945, and inactivity at the Big Bend mine, Yankee Hill district, Butte County, during 1946. The following five properties (operators in parentheses), listed in order of zinc output and each producing over 300,000 pounds in 1946, furnished 99 percent of the State total: Penn mine, Campo Seco district, Calaveras County (Shawmut Copper Mine Co.); Hornet mine, Flat Creek district, Shasta County (The Mountain Copper Co., Ltd.); Darwin group, Coso district, Inyo County (Anaconda Copper Mining Co.); and the Carbonate King mine (J. Q. Little under contract from Crystal Cave Mining Co.) and Mohawk mine (Emerson A. Ray et al.), both in the Clark Mountain district, San Bernardino County. Monthly production of zinc in 1946 was uneven, but a downward trend was evident during the latter half of the year.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in California in 1946, by counties, in terms of recovered metals

County	Mines producing [1]		Gold					
			Lode		Placer		Total	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Amador	10	9	618	$21,630	2,020	$70,700	2,638	$92,330
Butte	4	12	67	2,345	21,886	766,010	21,953	768,355
Calaveras	9	10	4,316	151,060	2,286	80,010	6,602	231,070
Del Norte	1		24	840			24	840
El Dorado	4	9	448	15,680	2,275	79,625	2,723	95,305
Fresno	1	4	18	630	254	8,890	272	9,520
Humboldt		1			64	2,240	64	2,240
Imperial	2		203	7,105			203	7,105
Inyo	16		3,096	108,360			3,096	108,360
Kern	17	3	2,673	93,555	33	1,155	2,706	94,710
Los Angeles		1			36	1,260	36	1,260
Madera		3			55	1,925	55	1,925
Mariposa	9	3	3,378	118,230	112	3,920	3,490	122,150
Merced		3			3,732	130,620	3,732	130,620
Mono	3	1	155	5,425	771	26,985	926	32,410
Nevada	6	4	54,242	1,898,470	926	32,410	55,168	1,930,880
Orange	1		14	490			14	490
Placer	3	14	39	1,365	3,077	107,695	3,116	109,060
Plumas	4	4	201	7,035	150	5,250	351	12,285
Riverside	2		3	105			3	105
Sacramento		10			100,275	3,509,625	100,275	3,509,625
San Bernardino	17	1	3,310	115,850	1,591	55,685	4,901	171,535
San Diego	1		2	70			2	70
San Francisco		[2]			28	980	28	980
San Joaquin		3			13,715	480,025	13,715	480,025
Shasta	6	10	1,220	42,700	11,605	406,175	12,825	448,875
Sierra	11	8	11,248	393,680	179	6,265	11,427	399,945
Siskiyou	8	22	78	2,730	8,628	301,980	8,706	304,710
Stanislaus		2			24,158	845,530	24,158	845,530
Trinity	2	23	24	840	13,938	487,830	13,962	488,670
Tuolumne	12	2	1,621	56,735	41	1,435	1,662	58,170
Yuba	1	10	54	1,890	57,937	2,027,795	57,991	2,029,685
Total: 1946	150	172	87,052	3,046,820	269,772	9,442,020	356,824	12,488,840
1945	87	99	54,458	1,906,030	93,480	3,271,800	147,938	5,177,830

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1946, by counties, in terms of recovered metals—Continued

County	Silver					
	Lode		Placer		Total	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Amador	15,366	$12,416	260	$210	15,626	$12,626
Butte	11	9	1,612	1,302	1,623	1,311
Calaveras	111,094	89,764	276	223	111,370	89,987
Del Norte	21	17			21	17
El Dorado	1,024	827	294	238	1,318	1,065
Fresno			42	34	42	34
Humboldt			8	6	8	6
Imperial	62	50			62	50
Inyo	970,167	783,895			970,167	783,895
Kern	8,619	6,964	10	8	8,629	6,972
Los Angeles			5	4	5	4
Madera			19	15	19	15
Mariposa	1,080	873	31	25	1,111	898
Merced			341	276	341	276
Mono	863	697	121	98	984	795
Nevada	12,596	10,178	102	82	12,698	10,260
Orange	2,785	2,250			2,785	2,250
Placer	7	6	334	270	341	276
Plumas	55	44	16	13	71	57
Riverside	92	74			92	74
Sacramento			5,354	4,326	5,354	4,326
San Bernardino	97,107	78,462	304	246	97,411	78,708
San Diego						
San Francisco			3	2	3	2
San Joaquin			1,361	1,100	1,361	1,100
Shasta	98,636	79,698	1,507	1,218	100,143	80,916
Sierra	2,110	1,705	30	24	2,140	1,729
Siskiyou	17	14	1,191	962	1,208	976
Stanislaus			1,824	1,474	1,824	1,474
Trinity	21	17	1,407	1,137	1,428	1,154
Tuolumne	1,090	881	5	4	1,095	885
Yuba	7	6	3,364	2,718	3,371	2,724
Total: 1946	1,322,830	1,068,847	19,821	16,015	1,342,651	1,084,862
1945	980,748	697,421	6,050	4,302	986,798	701,723

County	Copper		Lead		Zinc		Total Value
	Pounds	Value	Pounds	Value	Pounds	Value	
Amador	2,008,000	$325,296					$430,252
Butte							769,666
Calaveras	1,834,000	297,108	320,000	$34,880	6,602,000	$805,444	1,458,489
Del Norte							857
El Dorado	70,000	11,340					107,710
Fresno							9,554
Humboldt							2,246
Imperial							7,155
Inyo	446,000	72,252	18,620,000	2,029,580	1,786,000	217,892	3,211,979
Kern							101,682
Los Angeles							1,264
Madera							1,940
Mariposa							123,048
Merced							130,896
Mono	2,000	324	4,000	436			33,965
Nevada							1,941,140
Orange			6,000	654	34,000	4,148	7,542
Placer							109,336
Plumas							12,342
Riverside							179
Sacramento							3,513,951
San Bernardino	84,000	13,608	862,000	93,958	1,480,000	180,560	538,369
San Diego							70
San Francisco							982
San Joaquin							481,125
Shasta	4,036,000	653,832	34,000	3,706	3,852,000	469,944	1,657,273
Sierra							401,674
Siskiyou							305,686
Stanislaus							847,004
Trinity							489,824
Tuolumne							59,055
Yuba							2,032,409
Total: 1946	8,480,000	1,373,760	19,846,000	2,163,214	13,754,000	1,677,988	18,788,664
1945	12,946,000	1,747,710	14,448,000	1,242,528	19,846,000	2,282,290	11,152,081

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

[2] Output from property not classed as a "mine."

MINING INDUSTRY

The tonnage of material from lode mines in California treated in 1946 decreased 13 percent compared with 1945, but the yardage at placer mines increased 163 percent. The output of lode gold increased 60 percent, but the gold from this source accounted for only 24 percent of the State total, whereas production from placer mines advanced 189 percent and accounted for 76 percent of the total. The decrease in base-metal ore production was less than the increase in gold-ore output. The average recoverable gold content of gravels increased 10 percent.

Dredges of the connected-bucket type washed 93 percent of the total gravel mined in the State in 1946 and recovered 91 percent of the total placer gold. Dragline dredging increased markedly; equipment of this type washed 5 percent of the total gravel mined and recovered 6 percent of the placer gold, the highest point reached by dragline dredging in yardage washed or gold recovered since 1942.

All other placer-mining methods showed increases in gravel washed and gold recovered except drift mining, which recovered less gold in 1946 from a larger quantity of material handled. No Becker-Hopkins dredges have been reported in production since 1942, but suction dredging made its appearance in 1946 for the first time since that year. The prospect of an increase in the suction-dredge type of operation seems favorable.

Although the number of hydraulic mines in operation in 1946 was the same as in 1945, the quantity of gold recovered and gravel handled increased 24 and 57 percent, respectively. The number of drift mines operating in 1946 was the same as in 1945, but the quantity of gold recovered was less from a greater yardage of gravel handled; once very productive in California, this type of mining has shown no signs of recovering from the war-time decline.

ORE CLASSIFICATION

Of the 627,767 tons of ore (including 73,203 tons of old tailings) sold or treated in 1946, 53 percent was gold ore, 16 percent zinc-copper, 14 percent copper, 9 percent lead, 7 percent zinc, and 1 percent zinc-lead and gold-silver. Silver ore sold or treated was negligible in quantity. Details of ore classification are given in the Gold and Silver chapter of this volume.

Ore and old tailings sold or treated in California in 1946, with content in terms of recovered metals

Source	Material sold or treated		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
	Ore (short tons)	Old tailings (short tons)					
Dry and siliceous gold ore	[1] 327,991	3,780	[2] 79,776	[2] 48,931	[2] 273,500	7,600	
Dry and siliceous gold-silver ore	3,199		1,713	44,743	2,300	7,700	
Dry and siliceous silver ore	53	634	7	2,386	3,600	38,600	
	[1] 331,243	4,414	[2] 81,496	[2] 96,060	[2] 279,400	53,900	
Copper ore	21,739	64,558	[3] 348	[3] 21,018	[3] 2,407,300	5,100	
Lead ore	53,099	4,231	1,275	956,860	221,700	18,818,600	1,713,000
Zinc ore	45,043		3,271	133,841	1,651,300	338,600	7,752,400
Zinc-copper ore	99,176		609	94,234	3,889,800	28,900	3,852,000
Zinc-lead ore	4,264		53	20,817	30,500	600,900	436,600
Total lode mines	[1] 554,564	73,203	[2] [3] 87,052	[2] [3] 1,322,830	[2] [3] 8,480,000	19,846,000	13,754,000
Placers			269,772	19,821			
Total: 1946	[1] 554,564	73,203	[2] [3] 356,824	[2] [3] 1,342,651	[2] [3] 8,480,000	19,846,000	13,754,000
1945	497,666	220,303	147,938	986,798	[4] 12,946,000	14,448,000	19,846,000

[1] Excludes tungsten ore.
[2] Includes metal recovered from tungsten ore.
[3] Includes metal recovered from pyritic ore (residue).
[4] Includes 61,100 pounds from precipitates.

METALLURGIC INDUSTRY

During 1946, 59 percent of the total ore and old tailings handled was treated at amalgamation and cyanidation mills, 30 percent was treated at concentrating mills, and 11 percent was shipped for direct smelting. Smelters also received 38,166 tons of flotation concentrates and 15 tons of gravity concentrates from California mine operators. Comparing 1946 with 1945, material treated at cyanidation mills was slightly lower, whereas the quantity of material amalgamated increased 120 percent. The tonnage of crude ore and old tailings smelted remained virtually unchanged, and the quantity of ore and old tailings concentrated decreased 61 percent.

Companies producing most of California's lode gold in 1946 owned and operated their own metallurgical plants. Included with the few mills that did receive custom gold ore were Burton Bros., Inc., Rosamond (treatment by cyanidation), and Butte Lode Mining Co., Randsburg (amalgamation), both in Kern County. The Empire Star Mines Co., Ltd., Grass Valley, Nevada County, cyanided some lots of concentrates. The Selby lead plant of the American Smelting & Refining Co. at Selby, Contra Costa County—the State's only smelter—was closed from February 25 to June 17 as a result of the widespread strike that similarly affected many of the smelters in the Western States.

Mine production of metals in California in 1946, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (Short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore and old tailings amalgamated	365,190	45,838	8,355			
Ore, old tailings, and concentrates cyanided	24,939	27,372	16,407			
Concentrates smelted:						
Flotation	38,166	8,840	331,932	6,027.300	3,520,800	10,871,500
Gravity	15	56	22			
Ore and old tailings smelted	70,640	4,946	966,114	2,452,700	16,325,200	2,882,500
Total lode mines		87,052	1,322,830	8,480,000	19,846,000	13,754,000
Placers		269,772	19,821			
Total: 1946		356,824	1,342,651	8,480,000	19,846,000	13,754,000
1945		147,938	986,798	12,946,000	14,448,000	19,846,000

Mine production of metal from amalgamation and cyanidation mills (with or without concentration equipment) in California in 1946, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated		Recovered in bullion		Concentrates smelted and recovered metal					
	Ore [1] (short tons)	Old tailings (short tons)	Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Amador	784	70	430	125						
Butte	78		56	7						
Calaveras	102,128		657	288	9,973	3,634	110,232	1,655,000	320,000	6,602,000
El Dorado	1,915		102	19	38	239	132	100		
Fresno	56		18							
Imperial	46	3,182	203	62						
Inyo	79		40	5						
Kern	2,317	258	598	173						
Mariposa	4,388		2,300	698	101	1,078	382			
Mono	1,665		152	57						
Nevada	220,375		29,003	4,624						
Placer	37		34	7						
Plumas	3,415		104	26	21	82	24			
San Bernardino	170		22	6						
San Diego	3		2							
Shasta	1,116		278	50	58	296	70			
Sierra	8,832	270	11,215	2,103	6	4	1			
Siskiyou	320		78	17						
Trinity	6		3	2						
Tuolumne	13,580		489	79	487	1,132	1,011			
Yuba	100		54	7						
Total: 1946	361,410	3,780	45,838	8,355	10,684	6,465	111,852	1,655,100	320,000	6,602,000
1945	163,987	16	27,671	4,875	2,102	5,918	3,086	18,000	400	

CYANIDATION MILLS

Inyo	1,050		87	2						
Kern	4,436		2,075	8,446						
Nevada	19,453		25,210	7,959						
Total: 1946	24,939		27,372	16,407						
1945	27,212	368	11,992	6,587						
Grand total:										
1946	386,349	3,780	73,210	24,762	10,684	6,465	111,852	1,655,100	320,000	6,602,000
1945	191,199	384	39,663	11,462	2,102	5,918	3,086	18,000	400	

[1] Figures under "Ore" include both raw ore and concentrates amalgamated or cyanided, but not raw ore concentrated before amalgamation or cyandiation of concentrates.

Mine production of metals from concentrating mills in California in 1946, by counties, in terms of recovered metals

County	Material treated		Concentrates smelted and recovered metal					
	Ore (short tons)	Old tailings (short tons)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Calaveras	----	64, 558	1, 115	10	559	179, 000	----	----
El Dorado	3, 230	----	214	107	873	69, 900	----	----
Inyo	19, 335	----	4, 922	1, 691	121, 651	233, 500	3, 165, 900	383, 500
Orange	152	----	33	14	2, 785	----	6, 000	34, 000
Shasta	99, 176	----	21, 213	609	94, 234	3, 889, 800	28, 900	3, 852, 000
Total: 1946	121, 893	64, 558	[1] 27, 497	[1] 2, 431	[1] 220, 102	[1] 4, 372, 200	3, 200, 800	4, 269, 500
1945	272, 348	207, 000	53, 750	5, 558	304, 992	10, 932, 700	1, 054, 100	18, 160, 900

[1] Includes concentrates and metals from tungsten ore not included in material treated.

Gross metal content of concentrates produced from ores mined in California in 1946, by classes of concentrates

Class of concentrates	Concentrates (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	863	3, 404	2, 079	7, 079	1, 891	----
Copper	22, 117	4, 939	171, 787	5, 830, 044	434, 221	19, 420
Lead	4, 416	91	105, 808	690	3, 226, 552	534, 502
Zinc	10, 785	462	52, 280	378, 146	112, 119	10, 696, 131
Total: 1946	38, 181	8, 896	331, 954	6, 215, 959	3, 774, 783	11, 250, 053
1945	55, 852	11, 476	308, 078	11, 355, 211	1, 212, 745	20, 900, 483

Mine production of metal from California concentrates shipped to smelters in 1946, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Calaveras	11, 088	3, 644	110, 791	1, 834, 000	320, 000	6, 602, 000
El Dorado	252	346	1, 005	70, 000	----	----
Inyo	4, 922	1, 691	121, 651	233, 500	3, 165, 900	383, 500
Mariposa	101	1, 078	382	----	----	----
Orange	33	14	2, 785	----	6, 000	34, 000
Plumas	21	82	24	----	----	----
Shasta	21, 271	905	94, 304	3, 889, 800	28, 900	3, 852, 000
Sierra	6	4	1	----	----	----
Tuolumne	487	1, 132	1, 011	----	----	----
Total: 1946	38, 181	8, 896	331, 954	6, 027, 300	3, 520, 800	10, 871, 500
1945	55, 852	11, 476	308, 078	10, 950, 700	1, 054, 500	18, 160, 900

BY CLASSES OF CONCENTRATES

Dry gold	863	3, 404	2, 079	3, 800	----	----
Copper	22, 117	4, 939	171, 787	5, 664, 200	246, 000	----
Lead	4, 416	91	105, 808	100	3, 171, 700	387, 500
Zinc	10, 785	462	52, 280	359, 200	103, 100	10, 484, 000
Total 1946	38, 181	8, 896	331, 954	6, 027, 300	3, 520, 800	10, 871, 500

Gross metal content of California crude ore and old tailings shipped to smelters in 1946, by classes of material

Class of ore	Material shipped		Gross metal content				
	Ore (short tons)	Old tailings (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	3,753		1,744	3,849	39,466	9,623	
Dry gold-silver	3,199	148	1,717	44,743	2,461	7,891	
Dry silver	53	486	3	2,386	6,002	40,411	
Copper	18,475	3	[1] 230	[1] 19,526	[1] 2,208,973	[1] 7,798	
Lead	33,764	4,231	1,197	853,561	266,016	15,974,952	1,835,680
Zinc	2,416		16	24,017	50	18,939	1,588,638
Zinc-lead	4,112		39	18,032	36,002	605,260	556,137
Total: 1946	65,772	4,868	[1] 4,946	[1] 966,114	[1] 2,558,970	[1] 16,664,874	3,980,455
1945	57,583	12,919	3,319	661,208	[2] 2,108,391	13,760,492	2,324,687

[1] Includes metals from pyritic ore (residue) not included in material treated.
[2] Includes 22,000 pounds contained in precipitates.

Mine production of metals from California crude ore and old tailings shipped to smelters in 1946, in terms of recovered metals

BY COUNTIES

	Material shipped		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
	Ore (short tons)	Old tailings (short tons)					
Amador	18,476		188	15,241	2,008,000		
Butte	2		11	4			
Calaveras	6		15	15			
Del Norte	52		24	21			
Inyo	33,363	4,379	1,278	848,509	212,500	15,454,100	1,402,500
Mono		96	3	806	2,000	4,000	
Nevada	10		29	13			
Placer	4		5				
Plumas	23		15	5			
Riverside	43		3	92			
San Bernardino and Shasta [1]	13,781	393	[2] 3,325	[2] 101,383	[2] 230,200	[2] 867,100	1,480,000
Sierra	6		29	6			
Trinity	6		21	19			
Total: 1946	65,772	4,868	[2] 4,946	[2] 966,114	[2] 2,452,700	[2] 16,325,200	2,882,500
1945	57,583	12,919	3,319	661,208	[3] 1,995,300	13,393,500	1,685,100

BY CLASSES OF MATERIAL

Dry gold	3,753		1,744	3,849	38,100	7,600	
Dry gold-silver	3,199	148	1,717	44,743	2,300	7,700	
Dry silver	53	486	3	2,386	3,600	38,600	
Copper	18,475	3	[2] 230	[2] 19,526	[2] 2,156,600	[2] 5,100	
Lead	33,764	4,231	1,197	853,561	221,600	15,652,700	1,329,500
Zinc	2,416		16	24,017		18,600	1,150,400
Zinc-lead	4,112		39	18,032	30,500	594,900	402,600
Total 1946	65,772	4,868	[2] 4,946	[2] 966,114	[2] 2,452,700	[2] 16,325,200	2,882,500

[1] Combined to avoid disclosure of individual production.
[2] Includes metals from pyritic ore (residue) not included in material treated.
[3] Includes 22,000 pounds contained in precipitates.

REVIEW BY COUNTIES AND DISTRICTS

AMADOR COUNTY

East Belt District.—The Belden Amador Mines, Inc., worked the Belden mine during the latter half of December 1946, and Russell A. Donnelly worked the Peterson mine during the year; gold ore from each property was treated by amalgamation. The Garibaldi property was operated by dry-land dredging, using a dragline excavator; 89 ounces of gold and 8 ounces of silver were recovered from 2,900 cubic yards of gravel. The Union Flat (Elephant) mine was hydraulicked from February 1 to May 31, and 38 ounces of gold and 2 ounces of silver were recovered from 4,200 cubic yards of gravel.

Ione District.—The Pacific Mining Co., operating under contract from the Winston Copper Co., worked the Newton mine throughout 1946 and shipped 18,474 tons of copper smelting ore containing 181 ounces of gold, 15,240 ounces of silver and 2,049,076 pounds of copper.

Mother Lode District.—The Nevada Wabash Mining Co. operated the Nevada Wabash mine from August 2 to September 5, 1946, and treated the ore by amalgamation. R. S. Wilson and F. W. Sprung shipped 70 tons of old tailings from the Original Amador mine to the Nevada Wabash mill for treatment; 8 ounces of gold and 4 ounces of silver were recovered. The Argonaut Mining Co., Ltd., recovered a small quantity of gold from a clean-up at the idle Argonaut mine. The Mountain Gold Dredging Co. operated a 2½-cubic-yard dragline excavator and floating washing plant on the Burke Ranch and Skagg Ranch for 6 months in 1946; 95,900 cubic yards of gravel yielded 690 ounces of gold and 70 ounces of silver. Other dragline dredge operations included E. L. Lilly on the Cosumnes River west of Plymouth from August 22 through December 31, and Rimmer Dredge on the Cuneo Ranch from July 1 to August 4, 1946.

BUTTE COUNTY

Butte Creek District.—The Wyoming mine was operated from January 1 to April 1 and again from August 1 to December 30, 1946; a small quantity of gold was recovered by amalgamation. The Lancha Plana Gold Dredging Co. operated its connected-bucket dredge No. 5 (with 65 4½-cubic-foot buckets; electrically powered) on Butte Creek throughout 1946.

Oroville District.—Hoosier Gulch Placers operated a dragline dredge (boat No. 1) from August 23 to December 15. W. R. Clark operated a dragline dredge on the South Fork, Feather River, for 60 days; 20,400 cubic yards of gravel yielded 134 ounces of gold and 8 ounces of silver. Experimental mining of Oroville tailings with a dragline dredge was carried on from August 23 to October 11 by the Goldfield Consolidated Mines Co. During the first part of 1946 the Sunmar Dredging Co. operated a dragline dredge in the Oroville district; later in the year the equipment was moved to Mono County. Yuba Consolidated Goldfields, Butte unit, operated two connected-bucket dredges on land adjoining the Feather River throughout the year; both dredges were of the Yuba type, electrically powered, one having 84 9-cubic-foot buckets and the other 87 9-cubic-foot buckets. The Kister dredge of the Gold Hill Dredging Co. operated on the east

Mine production of gold, silver, copper, lead, and zinc in California in 1946, by counties and districts, in terms of recovered metals [1]

County and district [1]	Mines producing [2]		Ore and old tailings (short tons)	Gold			Silver (lode and placer) [3] (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode (fine ounces)	Placer (fine ounces)	Total (fine ounces)					
Amador County:											
Camanche [4]		3			274	274	22				$9,608
East Belt [5]	2	2	666	310	247	557	102				19,577
Ione	1	1	18,474	181	7	188	15,241	2,008,000			344,191
Mother Lode [6]	7	3	190	127	1,492	1,619	261				56,876
Butte County:											
Butte Creek	1	3	52	33	3,424	3,457	298				121,236
Enterprise		(7)			118	118	9				4,137
Forbestown		(7)			118	118	15				4,142
Magalia	1	(7)	2	11	118	129	16				4,528
Merrimac		(7)			118	118	9				4,137
Oroville	1	9	1	19	17,872	17,891	1,260				627,203
Yankee Hill	1	(7)	25	4	118	122	16				4,283
Calaveras County:											
Campo Seco	2		42,628	3,268		3,268	109,827	1,651,300	320,000	6,602,000	1,310,955
Copperopolis	3	1	121,811	544	34	578	896	182,600			50,535
Jenny Lind	1	1	2,240	488	85	573	371	100			20,371
Mother Lode [6]	2	8	11	11	2,163	2,174	270				76,308
West Belt		(7)			4	4					140
Del Norte County: Monumental	1		52	24		24	21				857
El Dorado County:											
Butcher Ranch [1]		1			318	318	42				11,164
East Belt [5]	(9)	1	(9)	(9)	12	[10] 12	[10] 2				[10] 422
Latrobe		1			21	21	4				738
Mother Lode [6]	3	6	4,455	240	1,924	2,164	1,136	70,000			87,998
Fresno County:											
Friant		4			254	254	42				8,924
Copper King	1		56	18		18					630
Humboldt County: Orleans		1			64	64	8				2,246
Imperial County:											
Cargo Muchacho	1		3,182	181		181	31				6,360
Mesquite Diggings	1		46	22		22	31				795
Inyo County:											
Cerro Gordo	1		338				261	1,300	22,300		2,852
Coso	6		39,995	454		454	871,091	171,700	15,416,300	1,708,500	2,636,361
Fish Springs	1		64	16		16	2				562
Modoc	1		3,891	59		59	19,960	21,000	558,800		82,504
Sherman	1		1,050	87		87	2				3,047
Slate Range	1		1,752	17		17	1,386	700	134,200	65,200	24,410
Ubehebe	1		109	1		1	118		17,200	12,300	3,506

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1946, by counties and districts, in terms of recovered metals [1]—Continued

County and district [1]	Mines producing [2]		Ore and old tailings (short tons)	Gold			Silver (lode and placer) [3] (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode (fine ounces)	Placer (fine ounces)	Total (fine ounces)					
Inyo County—Continued											
Union	1		112	70		70	658	1,000	4,600		$3,645
Wild Rose	1		15	24		24	3				842
Kern County:											
Mojave	2		4,451	2,087		2,087	8,450				79,873
Randsburg	13	3	2,290	537	33	570	152				20,073
Los Angeles County: San Gabriel		1			36	36	5				1,264
Madera County:											
Dennis		2			52	52	15				1,832
Raymond		1			3	3	4				108
Mariposa County:											
East Belt [5]	3	1	152	139	2	141	23				4,954
Hunter Valley	3	2	4,161	3,222	110	3,332	1,084				117,496
Mother Lode [6]	3		75	17		17	4				598
Merced County: Snelling		3			3,732	3,732	341				130,896
Mono County:											
Blind Springs	1		96	3		3	806	2,000	4,000		1,516
Homer	(9)	1	(9)	(9)	771	[10] 771	[10] 121				[10] 27,083
Masonic	1		60	58		58	31				2,055
Nevada County:											
French Corral		(7)			97	97	12				3,405
Grass Valley-Nevada City	4	(7)	202,343	48,862	171	49,033	11,930				1,725,794
Washington	(9)	2	(9)	(9)	89	[10] 89	[10] 8				[10] 3,121
You Bet		(7)			48	48	6				1,685
Orange County: Santa Rosa	1		152	14		14	2,785		6,000	34,000	7,542
Placer County:											
Auburn		(7)			50	50	7				1,756
Butcher Ranch [8]		1			1,210	1,210	137				42,461
Colfax		(7)			32	32	4				1,123
Dutch Flat		1			91	91	11				3,194
Foresthill		5			1,545	1,545	155				54,200
Iowa Hill	(9)	1	(9)	(9)	83	[10] 83	[10] 11				[10] 2,914
Last Chance		2			13	13	3				457
Lincoln		1			3	3					105
Ophir		3			50	50	6				1,755
Undistributed	1		4	5		5					175
Plumas County:											
Chester	1		17	4		4	1				141
Greenville	1		3,353	176		176	47				6,198

Johnsville	2		68	21		21	7				740
La Porte		2			54	54	4				1,893
Quincy		(7)			72	72	10				2,528
Rich		1			17	17	2				597
Seneca		1			3	3					105
Undistributed		(7)			4	4					140
Riverside County:											
Chuckawalla	1		3	3		3	3				107
Pinacate	1		40				89				72
Sacramento County: Folsom		8			93,718	93,718	4,779				3,283,991
San Bernardino County:											
Amboy	1		1				2	100			18
Buckeye	1		3,262	1,399		1,399	2,764	32,900			56,528
Calico	2		393	12		12	1,369	3,800	34,000		5,848
Clark Mountain	2		6,997	54		54	47,234	40,600	812,200	1,480,000	315,722
Fremont Peak	1		2				13				11
Kelso	1		51	1		1	825	200	5,800		1,366
Lead Mountain	1		39				232	1,400	6,400		1,112
Randsburg	2	1	3,329	1,727	1,591	3,318	44,537	2,000			152,440
Silver Mountain	1		1	2		2					70
Solo	3		226	83		83	203	2,100			3,409
San Diego County: Julian	1		3	2		2					70
San Francisco County: San Francisco		(7)			28	28	3				982
San Joaquin County:											
Camanche [4]		3			13,659	13,659	1,356				479,161
Undistributed		(7)			56	56	5				1,964
Shasta County:											
French Gulch	3	3	936	537	4,588	5,125	851				180,063
Igo		1			94	94	24				3,309
Old Diggings		(7)			35	35	5				1,229
Redding		6			6,853	6,853	742				240,455
Shasta	2	(7)	180	37	35	72	5				2,524
Sierra County:											
Alleghany	4	2	5,287	8,404	73	8,477	1,566				297,960
American Hill	1		220	27		27	5				949
Downieville	2	3	2,107	2,594	94	2,688	525				94,504
Pike	2		1,424	207		207	39				7,277
Poker Flat		2			11	11	2				387
Sierra City	2	1	70	16	1	17	3				597
Siskiyou County:											
Callahan		3			2,179	2,179	257				76,473
Cottonwood	2		183	18		18	4				633
Greenhorn		(7)			29	29	5				1,019
Humbug	1	(7)	10	5	8	13	4				458
Deadwood		2			280	280	47				9,838
Kalamath River	1	6	20	3	5,850	5,853	834				205,529
Liberty	2	5	75	31	221	252	36				8,849
Quartz Valley		1			4	4	1				141
Salmon River		3			41	41	8				1,441

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in California in 1946, by counties and districts, in terms of recovered metals [1]—Continued

County and district [1]	Mines producing [2]		Ore and old tailings (short tons)	Gold			Silver (lode and placer) [3] (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode (fine ounces)	Placer (fine ounces)	Total (fine ounces)					
Siskiyou County—Continued											
Scott Bar	(9)	1	(9)	(9)	8	[10] 8	[10] 7				[12] $286
Yreka	1		30	6		6	2				212
Yuba River		1			8	8					280
Trinity County:											
Cinnabar		1			15	15					
Coffee Creek		1			29	29	4				525
Hayfork		1			27	27	4				1,018
Helena	(9)	(7)	(9)	(9)	58	[10] 58	[10] 8				948
Junction City		6			10,847	10,847	1,037				[10] 2,036
Lewiston		1			27	27	2				380,483
New River		3			21	21	5				947
Sayler		1			4	4	1				739
Weaverville	1	7	6	21	487	508	71				141
Tuolumne County:											17,837
East Belt [5]	8		17	365		365	57				
Mother Lode [6]	4	2	13,563	1,256	41	1,297	1,038				12,821
Yuba County:											46,234
Camptonville		3			45	45	9				
Dobbins		2			42	42	17				1,582
Strawberry Valley	1		100	54		54	7				1,484
Other districts [11]	16	13	[12] 130,753	[13] 8,834	91,509	[13] 100,343	[13] 182,412	[13] 4,287,200	2,504,200	3,852,000	1,896
											5,096,822
Total California	150	172	[12] 627,767	[13] 87,052	269,772	[13] 356,824	[13] 1,342,651	[13] 8,480,000	19,846,000	13,754,000	18,788,664

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures; others producing listed in footnote 11 and their output included under "Other districts."

[2] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

[3] Sources of total silver as follows: 1,322,830 ounces from lode mines and 19,821 ounces from placers.

[4] Camanche district lies in Amador and San Joaquin Counties.

[5] East Belt district lies in Amador, Calaveras, Eldorado, Mariposa, and Tuolumne Counties.

[6] Mother Lode district lies in Amador, Calaveras, Eldorado, Mariposa, and Tuolumne Counties.

[7] Output from property not classed as a "mine."

[8] Butcher Ranch district lies in Eldorado and Placer Counties.

[9] Included under "Other districts."

[10] Exclusive of lode output, which is included under "Other districts."

[11] Includes following: East Belt district [5] in Calaveras and Eldorado Counties; Bishop Creek and Resting Springs in Inyo County; Green Mountain and Sageland in Kern County; Homer in Mono County; North Bloomfield, Washington (lode), and Yuba River in Nevada County; Iowa Hill (lode) in Placer County; Cosumnes River and Ione in Sacramento County; Ivanpah in San Bernardino County; Flat Creek in Shasta County Scott Bar in Siskiyou County; La Grange in Stanislaus County; Helena (lode) and Trinity Center in Trinity County; and Yuba River in Yuba County.

[12] Excludes tungsten ore.

[13] Includes metal recovered from tungsten ore.

side of the Feather River about 7 miles south of Oroville throughout the year; the electrically powered connected-bucket dredge has 72 9-cubic foot buckets. The Morris Ravine Mining Co. produced 108 ounces of gold and 9 ounces of silver from 530 cubic yards of gravel at the Morris Ravine drift mine from January 1 to August 9, 1946.

CALAVERAS COUNTY

Campo Seco District.—The Penn mine was operated throughout 1946—for the first 6 months by the Eagle Shawmut Mine and subsequently by a newly formed corporation known as Shawmut Copper Mine Co., the principal officers being the same; 42,627 tons of zinc ore were trucked to the Eagle Shawmut mill for treatment by amalgamation and selective flotation. Copper concentrate (3,233 tons containing 2,679 ounces of gold, 80,971 ounces of silver, 1,453,472 pounds of copper, 413,649 pounds of lead, and 19,420 pounds of zinc) and zinc concentrate (6,588 tons containing 382 ounces of gold, 28,802 ounces of silver, 249,533 pounds of copper, 92,701 pounds of lead, and 6,735,986 pounds of zinc) were shipped to smelters. In addition, 194 ounces of gold and 51 ounces of silver were recovered by amalgamation.

Copperopolis District.—The Mountain King mine was operated by the open-cut method by the Mountain King Mill & Mine (a limited partnership) from March 4 to September 6, 1946; gold ore was treated in the company 700-ton amalgamation-flotation plant, concentrate being shipped to a smelter. The Pacific Mining Co. operated a flotation plant on old tailings at the Union mine during the first half of 1946; 64,558 tons of material were treated to produce 1,115 tons of copper concentrate containing 10 ounces of gold, 559 ounces of silver, and 182,407 pounds of copper.

Jenny Lind District.—Matchett & Ruddy operated a dragline dredge 6 miles east of Bellota during the first 3 and last 2 months of 1946; 8,500 cubic yards of gravel yielded 85 ounces of gold and 4 ounces of silver. The Pacific Bridge Co. operated the Royal mine until August 1946, under lease from Frank S. Tower. Gold ore was treated in a 30-stamp mill by amalgamation and flotation; the concentrate was shipped to a smelter.

Mother Lode District.—Several placer mines were operated by the dragline dredging method during 1946. The Angels Dredging Co. operated on Angels Creek from August 25 to September 5; Grant Mining Co. on Gomez, Roberts, Ponte, Cuneo, and Basco leases along San Antonio Creek from February 1 to December 31 (300,000 yards of gravel yielded 1,410 ounces of gold and 182 ounces of silver); Wolsco Dredging Co. on Oneta, Huberty, P. G. & E., Guttinger, Ferron, and Hogate properties from March 17 to July 25; and Gavrilko Bros. Gold Dredging Co. on Willow Creek from March 18 to May 11. The Mole Mining Co. operated a drift mine near Railroad Flat from January 15 to July 10.

EL DORADO COUNTY

Butcher Ranch District.—The French Corral Gold Dredging Co. (formerly Golden Feather Dredging Co.) operated an electric dragline excavator on the Middle Fork of the American River (about 8

miles northeast of Auburn) in El Dorado and Placer Counties; operations in El Dorado County lasted from March 6 to April 4.

East Belt District.—Cosumnes Mines, Inc., operated the Cosumnes mine at Grizzly Flat throughout 1946 treating gold ore in a 60-ton amalgamation-flotation plant; concentrate was shipped to a smelter.

Mother Lode District.—Operation of the Pioneer-Lilyama mine by Pioneer-Lilyama Mines (O. H. Griggs) throughout 1946 was limited to development work; 214 tons of copper concentrate (containing 107 ounces of gold, 873 ounces of silver, and 71,883 pounds of copper) from copper ore treated in the company 250-ton flotation mill were shipped to a smelter. Joseph L. Liddicoat operated the Grit mine during the last 4 months of 1946 and treated gold ore by amalgamation. Norden and Baskin test-treated 1,050 tons of old dump ore from the Davidson mine by amalgamation and flotation; concentrate produced was shipped to a smelter. Operations in the mine during 1946 were limited to rehabilitation and development. Several dragline dredges operated during 1946, including R. H. Nelson on the Boarman estate from January 3 to August 10, El Dorado Dredging Co. on the Galloway property for 2 weeks in December, Henness & Legare on the Ostenrider property throughout the year (66,000 cubic yards of gravel yielded 457 ounces of gold and 38 ounces of silver), and the River Pine Mining Co. on the North Fork of the Cosumnes River from August 5 to December 10 (90,000 cubic yards of gravel yielded 438 ounces of gold and 64 ounces of silver). The Allen Gold Dredge Co. operated a suction dredge on Bacchi Ranch from July 20 to December 3.

FRESNO COUNTY

Friant District.—Gold was recovered as a byproduct from commercial sand and gravel operations by the Grant Pacific Rock Co. and by Pacific Coast Aggregates, Inc. (formerly Grant Service Rock Co. Consolidated), from its Rockfield plant 2 miles south of Friant.

HUMBOLDT COUNTY

Orleans District.—The Pearch hydraulic mine operated during April and May 1946; 64 ounces of gold and 8 ounces of silver were recovered.

IMPERIAL COUNTY

Cargo Muchacho District.—The Homestake Mining Co. treated old tailings from the Tumco mine by cyanidation during 1946.

Mesquite Diggings District.—Van Derpoel & Murphy operated the Mary Lode mine from March 1 to May 1, 1946; gold ore was treated in the company 25-ton amalgamation-cyanidation mill.

INYO COUNTY

Bishop Creek District.—The United States Vanadium Corp. produced, by flotation, a copper concentrate containing a substantial quantity of silver as a byproduct of ore treated primarily for tungsten.

Cerro Gordo District.—L. D. Foreman & Co. shipped material to a smelter from the Cerro Gordo old slag dump.

Coso District.—The Darwin mine (the largest producer of silver and lead in the State) was operated by the Anaconda Copper Mining Co.

throughout 1946. A total of 18,135 tons of lead ore was treated in the company 150-ton bulk flotation plant on the property to produce 4,377 tons of lead concentrate (containing 71 ounces of gold, 103,030 ounces of silver, 3,205,216 pounds of lead, and 527,314 pounds of zinc), which was shipped to a smelter; no zinc concentrate was produced in 1946. In addition, 20,958 tons of lead ore containing 366 ounces of gold, 762,842 ounces of silver, 196,345 pounds of copper, 12,329,098 pounds of lead, and 1,806,209 pounds of zinc were shipped for direct smelting. L. D. Foreman & Co. shipped material to a smelter from the Eagle tailings dump and the Last Chance old-slag dump. Dopplemayer & Crandell worked the Empress mine beginning June 1, 1946, and shipped 79 tons of lead ore containing 1 ounce of gold, 530 ounces of silver, 2,033 pounds of copper, 34,891 pounds of lead, and 12,539 pounds of zinc to a smelter. Theodore Peterson shipped zinc-lead ore to a smelter from the Silver Spoon mine.

Modoc District.—L. D. Foreman & Co. shipped lead ore and old slag, containing a substantial quantity of silver, to a smelter from the Modoc property.

Resting Springs District.—The Finley Co. (Shoshone Division) operated the Columbia No. 2 mine from January 1 to 28 and from July 5 through the balance of 1946; lead ore containing a substantial quantity of silver was shipped to a smelter.

Slate Range District.—Damon & Damon worked the Gold Bottom and Ophir mines during 1946; zinc-lead ore and lead ore was shipped for direct smelting, and flotation lead concentrate was shipped to a smelter.

Ubehebe District.—George Lippincott worked the Lead King mine during March, April, and May 1946 and shipped 109 tons of lead ore (containing 1 ounce of gold, 118 ounces of silver, 17,519 pounds of lead, and 16,932 pounds of zinc) to a smelter.

Union District.—T. L. Bright shipped gold ore to a smelter from the Reward (Brown Monster) mine.

KERN COUNTY

Green Mountain District.—Mattie Moreland amalgamated ore from the Evening Star group during an operating period from April 15 to August 30, 1946.

Mojave District.—Burton Bros., Inc., cyanided 4,436 tons of gold ore from the Tropico mine (including a minor tonnage from the Yellow Dog and Standard Hill mines) during 1946 and recovered 2,075 ounces of gold and 8,446 ounces of silver.

Randsburg District.—A number of small mines in the district (including the Alphonso, American Gold Coin, Barnett, Big Dyke, Florence, King Soloman, Marie Rose, Minnesota, New Deal, and Wade) were worked at various times during 1946; gold ore from virtually all the mines was treated by amalgamation at the 30-ton custom stamp mill operated by the Butte Lode Mining Co. at Randsburg. The Butte Lode Mining Co., operating the Butte Lode mine (five claims) throughout the year, treated 1,127 tons of gold ore and 258 tons of old tailings by amalgamation in the company mill and recovered 186 ounces of gold and 56 ounces of silver. T. B. Peterson worked the Lucky Boy mine from July 9 to September 20 and again

from November 1 to December 23; 161 ounces of gold and 39 ounces of silver were recovered from 186 tons of gold ore treated by amalgamation in the Butte Lode Mining Co. mill. Gates, Atkinson & Cavalli also shipped ore to the Butte Lode Mining Co. mill from the Sunshine and Nine Spot claims during 1946; 101 tons of gold ore yielded 36 ounces of gold and 9 ounces of silver.

Sageland District.—Curtis & Prout operated the St. Johns group from January 1 to November 15, 1946; gold ore was treated in a 24-ton mill using a ball mill, jig, and amalgamation barrel.

LOS ANGELES COUNTY

San Gabriel District.—The Azusa Rock & Sand Co. recovered 36 ounces of gold and 5 ounces of silver as byproducts of its commercial sand and gravel plant operation on the San Gabriel River channel during 1946.

MARIPOSA COUNTY

East Belt District.—H. N. Hammond & Partners worked the Early mine during May, June,and July and again in September and October 1946; gold ore was treated by amalgamation, and a small quantity of concentrate was shipped to a smelter. The Schroeder group was operated by Schroeder & Moss during 1946; 30 tons of gold ore treated by amalgamation in a 20-ton Huntington mill yielded 107 ounces of gold and 14 ounces of silver. B. W. Spurgeon worked the Summit mine during an operating period April 1 to October 15 and treated free-milling gold ore by amalgamation.

Hunter Valley District.—The Mount Gaines Mining Co. operated the Mount Gaines mine throughout the year and amalgamated 4,160 tons of ore from which were recovered bullion (containing 2,115 ounces of gold and 653 ounces of silver) and 100 tons of flotation concentrate containing 1,070 ounces of gold, 377 ounces of silver, 486 pounds of copper, and 1,265 pounds of lead. The Trebor Corp. operated a 2-cubic-yard dragline excavator and floating washing plant on Burns Creek near Hornitos during a 2-month period in 1946; 15,000 cubic yards of gravel yielded 108 ounces of gold and 31 ounces of silver.

Mother Lode District.—The Our Chance, Specimen, Yucatan, and Manzanita mines were worked during relatively short periods in 1946, small quantities of gold being recovered by amalgamation at each property.

MERCED COUNTY

Snelling District.—The Merced Dredging Co. operated its dredge No. 1 (electrically powered and equipped with 60 9½-cubic-foot buckets) on the Merced River ¾ mile from Snelling from September 6 to December 31. Dredging was resumed in September following a favorable court ruling on an injunction asked by the company against a county resoiling ordnance, which had halted operations on September 13, 1945. The Snelling Gold Dredging Co. operated its Yuba-type electric connected-bucket dredge (with 66 7-cubic-foot buckets) on the Merced River near Snelling from September 8 to December 31; the dredge is 1 of 2 that suspended operations October 15, 1942, because of the War Production Board Limitation Order

L–208. A small quantity of gold was recovered as a byproduct of gravel-washing operations at the Merced Sand & Gravel Co. plant on the Merced River.

MONO COUNTY

Blind Springs District.—L. D. Foreman & Co. shipped Benton tailings containing silver and some copper and lead to a smelter.

Homer District.—The Sunmar Dredging Co. operated a dragline dredge at the Dogtown Placers from March 25 to July 23, 1946; the equipment was the same as that used in the Oroville district, Butte County, earlier in the year. Log Cabin Mines Co. operated the Log Cabin mine, 7 miles north from Leevining, throughout 1946; gold ore was treated in a 100-ton amalgamation mill.

Masonic District.—Ed Byers worked the Chipmunk mine during the latter half of 1946 and recovered gold by amalgamation.

NEVADA COUNTY

Grass Valley-Nevada City District.—The Empire Star Mines Co., Ltd., suspended operations at its Empire, North Star, and Pennsylvania mines at Grass Valley, Nevada County, on July 1, because mining was unprofitable under conditions of high operating costs and a fixed price for gold. Ore produced from the Empire Star group during the first 6 months of 1946 was treated by amalgamation and cyanidation at the company plant; ore from the company properties at Browns Valley in Yuba County, as well as concentrates from several neighboring mines, also was treated at the plant, which operated throughout the year. The Idaho-Maryland Mines Corp. operated the Idaho-Maryland and Brunswick mines throughout the year; 186,664 tons of ore were treated by amalgamation followed by cyanidation of concentrates yielding 40,691 ounces of gold and 8,808 ounces of silver.

North Bloomfield District.—Western Gold, Inc., hydraulicked the Relief Hill mine from February 21 to June 20, 1946.

Washington District.—The Ancho Erie Mining Co. operated the Ancho and Erie groups throughout 1946; 18,039 tons of gold ore were milled, from which 3,472 ounces of gold and 378 ounces of silver were recovered by amalgamation. In addition, 1,905 ounces of gold and 312 ounces of silver were recovered from 271 tons of flotation concentrate produced at the company 100-ton plant and shipped to the Empire Star plant at Grass Valley for treatment by cyanidation. A 6-ton cyanide plant was installed late in 1946 for the treatment of concentrate to avoid shipping.

ORANGE COUNTY

Santa Rosa District.—The Blue Light Silver Mines Co. operated the Silverado mine from January 1 through June 3, 1946, on a small scale; 152 tons of zinc-lead ore (containing 16 ounces of gold, 3,082 ounces of silver, 547 pounds of copper, 6,773 pounds of lead, and 39,102 pounds of zinc) were shipped to a concentrator-smelter.

PLACER COUNTY

Butcher Ranch District.—The French Corral Gold Dredging Co. (Golden Feather Dredging Co.) operated an electric dragline dredge on the Middle Fork of the American River (Browns, Mammoth, and Little Kennebec bars) in El Dorado and Placer Counties; operations in Placer County lasted from January 3 to March 5 and from October 7 to November 29.

Foresthill District.—Horseshoe Bar Mines operated a dragline excavator and floating washing plant on the Middle Fork of the American River from April to December 1946. Gavrilko Bros. Gold Dredging Co. operated for a short period in September and October on Georgetown Creek.

Iowa Hill District.—The Drummond Mining Co. operated the Drummond mine on a small scale from January 20 to December 1, 1946; gold was recovered by amalgamation. A. H. Howe worked the Golden Stream and Bonanza claims on a small scale during the first half of 1946; gold ore from pockets was ground by hand, the gold being recovered by panning and amalgamation.

Ophir District.—A small quantity of gold was recovered as a by-product from a commercial sand and gravel operation at the Culbertson Gravel Co. plant during 1946.

PLUMAS COUNTY

Greenville District.—Technical Porcelain & Chinaware Co. operated the Plumas Quartz mine near Crescent Mills from June 1 to November 30, 1946. Gold was recovered by amalgamation and from flotation concentrates shipped to a smelter.

SACRAMENTO COUNTY

Cosumnes River District.—Thurman & Wright operated an electric connected-bucket dredge (with 86 6-cubic-foot buckets) 3 miles southeast of Sloughouse during 1946; operation of the dredge was begun February 8.

Folsom District.—The Capital Dredging Co. operated an electric connected-bucket dredge on its property 5 miles south of Folsom throughout 1946; the dredge was equipped with 100 18-cubic-foot buckets. The General Dredging Co. operated its 3-cubic-yard dragline excavator and floating washing plant on Alder Creek, 1½ miles west of Natoma, from June 1 to December 29, 1946. Dredge No. 4 of the Lancha Plana Gold Dredging Co. operated for 345 days in 1946 on the American River 8 miles south of Folsom; the dredge had 84 6-cubic-foot buckets. The Natomas Co., the leading California gold producer in 1946, operated all of its fleet of electric connected-bucket dredges throughout 1946 except dredge No. 8, which did not begin work until August. The number and size of buckets per dredge were: No. 1, 62 15-cubic-foot; No. 4, 67 15-cubic-foot; No. 5, 105 11-cubic-foot; No. 6, 106 11-cubic-foot; No. 7, 98 9-cubic-foot; No. 8, 105 12-cubic-foot; and No. 10, 83 15-cubic-foot. Recovery of gold as a byproduct of gravel-washing operations was reported by C. M. Craig at the Brighton Sand & Gravel, Del Paso Rock Products, and Perkins Gravel plants and by the Fair Oaks Gravel Co. at its

plant on the American River. The Fair Oaks Gravel Co. recovered 311 ounces of gold and 24 ounces of silver from 76,683 cubic yards of material handled.

Ione District.—The Wallace Dredging Co. operated an electric connected-bucket dredge (with 71 3-cubic-foot buckets) 8 miles west of Ione from January 27 to November 23, 1946.

SAN BERNARDINO COUNTY

Buckeye District.—Donald F. Love, lessee, shipped a substantial quantity of gold ore containing some silver and copper to a smelter from the Bagdad-Chase (Pacific) mine.

Calico District.—Louis Warnken, Jr., shipped old tailings containing silver and lead to a smelter from the Calico mine.

Clark Mountain District.—The Carbonate King mine was operated throughout 1946 by J. Q. Little under contract from the Crystal Cave Mining Co; 2,416 tons of zinc ore containing 16 ounces of gold, 24,017 ounces of silver, 50 pounds of copper, 18,939 pounds of lead, and 1,588,638 pounds of zinc were shipped to a smelter. Emerson A. Ray & Associates and lessees operated the Mohawk mine and shipped lead ore and zinc-lead ore to smelters.

Ivanpah District.—Verdi Development Co. shipped a small quantity of silver ore from the Albermarle mine, and Arthur J. Ansite shipped gold ore from the Beverly Glenn mine to a smelter in 1946.

Randsburg District.—Frank W. Royer worked the Kelly and Juanita mines during 1946 and shipped gold-silver ore to smelters. Floyd Holstrom operated the Pioneer group (H. & H. Nos. 1–5) from January 1 to July 27, 1946; 14 ounces of gold and 4 ounces of silver were recovered from 130 tons of gold ore treated by amalgamation in the Butte Lode Mining Co. mill. Hoefling Bros. recovered 1,591 ounces of gold and 304 ounces of silver from 500,000 cubic-yards of gravel, handled chiefly for scheelite, at the Spud Patch mine by dry-land dredging throughout 1946; equipment used included two electric and one Diesel dragline excavators with 1½-cubic-yard buckets and 2 portable washing plants.

Solo District.—Jerry Korfist treated gold ore from the Oro Fino mine by amalgamation. John L. Alexander shipped gold ore from the Telegraph mine to a smelter.

SAN FRANCISCO COUNTY

San Francisco District.—Five separate operators using small-scale hand methods recovered 28 ounces of gold and 3 ounces of silver from beach sand during short periods of operation in 1946.

SAN JOAQUIN COUNTY

Camanche District.—The Gold Hill Dredging Co. operated its Upper Comanche connected-bucket dredge (with 64 7½-cubic-foot buckets) and Lower Comanche dredge (with 76 8½-cubic-foot buckets) along the Mokelumne River throughout 1946. The Mokelumne Sand & Gravel Co. recovered gold as a byproduct from its commercial gravel washing operations during 1946.

SHASTA COUNTY

Flat Creek District.—The Mountain Copper Co., Ltd., largest mineral producer in Shasta County, worked the Hornet mine throughout 1946. Zinc-copper ore from the Mattie ore body was treated in the company 400-ton selective flotation mill to produce copper and zinc concentrates, which were shipped to smelters. A small quantity of gold, silver, and copper was recovered from smelting cinder derived from burning pyrites in a sulfuric acid plant; the pyrites was produced at the Hornet mine.

French Gulch District.—The French Gulch Dredging Co. operated its connected-bucket electric-powered dredge (with 76 4½-cubic-foot buckets) on Clear Creek from January 1 to July 27, 1946; the dredge was then moved to a new location on Indian Creek—Deadwood district in Siskiyou County. Also on Clear Creek, a dragline dredge was operated by Enterprise Engineering Co. from March 11 to May 2. The G & H Mining Co. operated a ¾-cubic-yard dragline dredge on Cline Gulch from September 1 to October 22; 60,000 cubic yards of material yielded 107 ounces of gold and 13 ounces of silver. The St. Jude Mining Co. worked the St. Jude mine and treated gold ore by amalgamation and concentration; the concentrate was shipped to a smelter. J. H. Scott Co. operated the Washington mine throughout 1946 and treated 590 tons of gold ore by amalgamation (yielding 36 ounces of gold and 8 ounces of silver) followed by concentration; the flotation concentrate (18 tons containing 37 ounces of gold and 4 ounces of silver) was shipped to a smelter.

Redding District.—The Thurman Gold Dredging Co. operated its connected-bucket dredge (with 72 9-cubic-foot buckets) on Clear Creek about 4 miles south of Redding throughout 1946. Dragline dredges were operated in the Redding district during 1946 by the Sandra Gold Dredging Co. on Tadpole Creek and by Artie E. Griffith (Red Gulch No. 1). Chris Kutras conducted placer operations on the Kutras tract during the year.

Shasta District.—Tom Cook worked the Judy claim, and Austin H. Merrill operated the Yankee John mine during 1946; gold ore from both properties was treated by amalgamation.

SIERRA COUNTY

Alleghany District.—The American Hill (Pilgrim) mine was worked from October 15 to December 20, 1946, by American Hill Mines; 600 tons of gold ore was treated by amalgamation (yielding 145 ounces of gold and 22 ounces of silver) followed by concentration; 6 tons of gravity concentrate containing 4 ounces of gold and 1 ounce of silver were shipped to a smelter. Maurice Derrnau produced a small quantity of gold from the Eureka mine, and the Dickey Exploration Co. reopened the Oriental mine in April 1946. The Original Sixteen to One Mine, Inc., operated its Original Sixteen to One mine throughout 1946 and recovered a substantial quantity of gold and some silver by amalgamation.

Downieville District.—Alfred L. Merritt operated the Brush Creek mine, 1½ miles south of Goodyears bar, throughout 1946; 2,102 tons of ore treated by amalgamation yielded 2,583 ounces of gold and 510 ounces of silver.

Pike District.—Harvey L. Sorensen, lessee, recovered gold by amalgamation at the Alaska mine in 1946. The Bowman mine was operated by David H. Casey until July 1946; 1,364 tons of gold ore treated by amalgamation yielded 196 ounces of gold and 36 ounces of silver.

SISKIYOU COUNTY

Callahan District.—Yuba Consolidated Gold Fields (Siskiyou unit) operated its electric connected-bucket dredge (Yuba type with 72 9-cubic-foot buckets) on the Scott River from January 1 to April 15, 1946.

Cottonwood District.—A minor quantity of gold was recovered by amalgamating ore from the Golden Rule mine (operated by Robert Clay, Jr.) and the Nims mine (operated by the Marath Mining Corp.) during 1946.

Deadwood District.—The West Branch Dredging Co. operated a 1½-cubic-yard dragline excavator and floating washing plant on the Good-Luck, Kentuck, and O. K. claims on Indian Creek from March 1 to June 15, 1946; 30,000 cubic yards of gravel yielded 119 ounces of gold and 27 ounces of silver. The French Gulch Dredging Co. began operating its connected-bucket dredge on Indian Creek November 20, 1946; the equipment had been moved from the former site of company operations on Clear Creek, French Gulch district, Shasta County.

Klamath River District.—The Yreka Gold Dredging Co. operated its electric connected-bucket dredge (with 67 6-cubic-foot buckets) in Seiad Valley throughout 1946. Scandia Mines (Larsen & Harms) operated two dragline dredges (each dragline excavator was equipped with a 3-cubic-yard bucket) at Scandia Nos. 1, 2, and 3 mines at different periods throughout 1946; 679,500 cubic yards of gravel handled yielded 2,854 ounces of gold and 457 ounces of silver.

Liberty District.—Hydraulicking was carried on during 1946 at the Joubert mine by Alex Markon and at the Judge mine by Judge Hydraulic Mine. Norman Marvin worked the Hansen mine and Alex Markon the Anna Johnson mine during 1946; a small quantity of gold ore from each property was treated by amalgamation. Harry M. Thompson conducted sampling operations at the Quartz Hill mine during the latter part of 1946 to determine the possibility of milling; a few ounces of gold were recovered by amalgamating gold ore.

STANISLAUS COUNTY

La Grange District.—The La Grange Gold Dredging Co. operated its connected-bucket dredge No. 4 (with 62 10-cubic-foot buckets) on the Tuolumne River throughout 1946. The Tuolumne Gold Dredging Corp. operated its connected-bucket dredge throughout the year; the dredge is equipped with 100 12-cubic-foot buckets.

TRINITY COUNTY

Junction City District.—The Junction City Mining Co. operated its electric connected-bucket dredge (with 75 10-cubic-foot buckets) along Trinity River throughout 1946. The Chapman and Fisher mine was hydraulicked during the first half of 1946 by Chapman, Hill, McCartney & Loft; 12,000 cubic yards of gravel yielded 48 ounces of

gold and 4 ounces of silver. Gilzean Bros. and Hill, McCartney & Loft worked the Northern California Mines Co. property (Red Hill, Oak Hill, Montezuma, Evans & Bartlett, and Mammoth placers) under lease from the Goldfield Consolidated Mines Co. during the first half of 1946; gold was recovered principally by hydraulicking.

Trinity Center District.—The Carrville Gold Co. operated an electric connected-bucket dredge (with 77 12-cubic-foot buckets) on the Trinity River from March 20 to July 30 and again from December 9–31, 1946. The Thomson Divide Mining Co. operated its dragline excavator (with a 1½-cubic-yard bucket) and floating washing plant at the Squirrel Gulch mine throughout the year.

Weaverville District.—P. & W. Trinity Placers operated a dragline dredge at the P. & W. mine from August 1 to October 15, 1946. W. E. Woodberry conducted hydraulic operations at the Rex mine during a 3-month period in 1946; this was one of several placers worked in the district by this method during 1946.

TUOLUMNE COUNTY

East Belt District.—E. T. Harper worked the Grizzly and Eureka mines from March through December 1946; 55 ounces of gold and 12 ounces of silver were recovered by amalgamation from 1 ton of ore. Harry Gibson and H. C. Keenan worked the Hidden Treasure mine during 1946 and recovered 130 ounces of gold and 11 ounces of silver by amalgamation from 5 tons of ore. Several other lode mines were worked on a small scale during 1946 including the Lazar, Southern Cross, and Wind Wheel; a few ounces of gold from each property were recovered by amalgamation.

Mother Lode District.—Miller & Clemson (Eagle Shawmut Mine) operated the Eagle Shawmut mine from June 8, 1946, through the remainder of the year; 12,272 tons of gold ore treated in the company 500-ton flotation mill yielded bullion containing 56 ounces of gold and 16 ounces of silver and 479 tons of concentrate (containing 1,088 ounces of gold and 995 ounces of silver), which was shipped to a smelter. Tom Owen and George Marbut worked the Maryatt mine during 1946; gold was recovered by amalgamation and from concentrate shipped to a smelter.

YUBA COUNTY

Yuba River District.—Yuba Consolidated Gold Fields (Yuba unit) operated five connected-bucket dredges in the Yuba River Basin throughout 1946; the operation ranked second in production of gold in the State. The dredges are of the Yuba type, electrically operated, and had the following number and capacity of buckets: Two with 100 18-cubic-foot buckets; one with 126 18-cubic-foot buckets; one with 135 18-cubic-foot buckets; and one with 87 18-cubic-foot buckets.

Central States
Silver, Copper, Lead, and Zinc

(MINE REPORT)

By A. J. MARTIN

GENERAL SUMMARY

MOST of the copper, lead, and zinc mines in the Central States continued to operate under the Premium Price Plan throughout 1946. The removal of price ceilings from base metals, effective November 10, enabled some mines to put operations back on a competitive peacetime footing. The manpower shortage, an obstacle to economical operation, was ameliorated. The principal impediment to complete reconversion of the industry is the advanced stage of ore-reserve depletion in some areas. During the rearmament and early war period ore reserves were depleted at an abnormally high rate because of high production rates and neglect of development work. This condition led to utilization of much low-grade or "high-cost" ore, and mining and milling operations were sustained by premiums provided under the Premium Price Plan. The plan will expire June 30, 1947, unless the Congress extends it. In 1946 premiums represented 54 percent of the total price paid for Central States zinc concentrates, 25 percent for lead concentrates, and 32 percent for copper (mine output, excluding byproduct copper from lead smelters). Premium payments were generally higher in 1946 than in 1945 because of quota adjustments to compensate the decrease in the market price of zinc concentrates and increases in operating costs resulting from the general wage increase and the advance in prices of equipment and supplies. The market prices of concentrates and copper rose sharply after decontrol but were still less than the maximum prices provided under the Premium Price Plan as the year ended.

The output of recoverable zinc in 1946 decreased 1 percent from 1945, lead decreased 18 percent, and copper 30 percent. The copper tailing plants and all but one of the mines in Michigan were idle 5 weeks in May and June because of the coal shortage. In the Tri-State zinc-lead district (Kansas-Missouri-Oklahoma) nearly all operations were suspended about 3 weeks in July pending reinstatement of the Premium Price Plan, and a few mines were closed for other short periods by labor strikes. A strike closed five large lead mines in Southeastern Missouri from October 23 to 31.

The silver produced in the Central States is a minor byproduct derived from some of the base-metal ores. No production of gold has been reported from Central States mines since 1940.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices:

Prices of gold, silver, copper, lead, and zinc, 1942–46

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1942	$35.00	$0.711+	$0.121	$0.067	$0.093
1943	35.00	.711+	.130	.075	.108
1944	35.00	.711+	.135	.080	.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122

[1] Price under authority of Gold Reserve Act of January 31, 1934. Treasury legal coinage value of gold from January 18, 1837, to January 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] Treasury buying price for newly mined silver. 1942 to June 30, 1946: $0.71111111; July 1, 1946 to Dec. 31, 1946: $0.905.
[3] Yearly average weighted price of all grades of primary metal sold by producers; price includes bonus payments by Office of Metals Reserve for overquota production.

Mine production of silver, copper, lead, and zinc in the Central States, 1942–46, in terms of recovered metals

Year	Mines producing	Ore and old tailings (short tons)	Silver		Copper	
			Fine ounces	Value	Pounds	Value
1942	502	30,726,994	130,884	$93,073	93,958,000	$11,368,918
1943	407	32,653,764	161,917	115,141	96,208,000	12,507,040
1944	386	34,240,455	148,898	105,883	91,446,000	12,345,210
1945	334	31,873,116	118,883	84,539	67,600,000	9,126,000
1946	355	30,001,691	71,703	57,936	47,040,000	7,620,480

Year	Lead		Zinc		Total value
	Short tons	Value	Short tons	Value	
1942	235,229	$31,520,686	258,181	$48,021,666	$91,004,343
1943	217,060	32,559,000	222,707	48,104,712	93,285,893
1944	201,577	32,252,320	214,949	49,008,372	93,711,785
1945	201,520	34,661,440	164,225	37,771,750	81,643,729
1946	164,804	35,927,272	162,962	39,762,728	83,368,416

Mine production of silver, copper, lead, and zinc in the Central States in 1946, by months, in terms of recovered metals

Month	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	7,228	2,013	16,528	14,737
February	6,544	1,897	15,075	13,796
March	6,886	2,264	15,933	14,702
April	6,393	2,336	15,260	14,761
May	5,318	1,239	13,584	14,634
June	5,114	1,310	11,985	13,646
July	5,288	1,969	11,388	5,757
August	6,539	2,129	13,631	14,094
September	5,305	2,156	13,330	14,105
October	5,753	2,033	11,378	14,699
November	5,066	2,139	13,390	13,884
December	6,269	2,035	13,322	14,147
Total 1946	71,703	23,520	164,804	162,962

Silver.—The mine output of silver in the Central States in 1946 comprised 67,734 ounces recovered from lead bullion and smelter residues derived from Southeastern Missouri lead concentrates, 1,667 ounces from Missouri lead-copper ore, and 2,302 ounces from Southern Illinois zinc-lead fluorspar and lead fluorspar ores. Ordinarily some silver is recovered from Michigan copper ore, but none was reported from this source in 1946.

Copper.—Michigan contributed 92 percent and Missouri 8 percent of the Central States total mine output of copper in 1946. The Michigan output decreased 29 percent from 1945. The Quincy and Copper Range mines, in operation until August 1945, were idle throughout 1946; the Quincy reclamation plant continued to operate. The Missouri output of copper decreased 45 percent; there were decreases both in the quantity of byproduct copper-lead matte shipped from smelters treating Southeastern Missouri lead concentrates and in the quantity of copper concentrates shipped from the Madison mill at Fredericktown, which treated lead-copper ore.

Lead.—Lead production by mines in the Central States amounted to 164,804 tons in 1946 compared with 201,520 tons in 1945. The highest recorded annual output was 317,375 tons in 1925. In 1946 the disseminated-lead district of Southeastern Missouri produced 82 percent and the Tri-State district (Kansas, Southwestern Missouri, Oklahoma) 14 percent of the Central States total lead output; the rest came from Wisconsin, Illinois, Kentucky, Central Missouri, and Arkansas.

Zinc.—The 1-percent decrease in zinc output in the Central States in 1946 resulted from the drop in the quantity recovered from old tailings; the quantity recovered from newly mined ore increased. Of the 162,962 tons of zinc produced in 1946, the Tri-State district contributed 139,038 tons or 85 percent. A general review of mining and milling in this district is given in this chapter under Southwestern Missouri. Output in the Wisconsin-Northern Illinois district was 18,344 tons, or 11 percent of the Central States total. Other producing districts were Kentucky-Southern Illinois, Southeastern and Central Missouri, and Northern Arkansas.

MINE PRODUCTION BY STATES AND REGIONS

Mine production of silver, copper, lead, and zinc in the Central States in 1946, by States, in terms of recovered metals

State	Mines producing	Material sold or treated		Silver	
		Crude ore (short tons)	Old tailings (short tons)	Fine ounces	Value
Arkansas	3	4,302			
Illinois	18	[1] 288,942	103,491	2,302	$1,860
Kansas	82	2,980,313	1,314,012		
Kentucky	6	12,270			
Michigan	9	1,611,579	3,108,415		
Missouri	70	7,147,213	354,717	69,401	56,076
Oklahoma	114	3,699,762	8,509,891		
Wisconsin	53	314,819	551,965		
Total: 1946	355	16,059,200	13,942,491	71,703	57,936
1945	334	16,780,823	15,092,293	118,883	84,539

[1] Excludes lead-bearing material mined with fluorspar and from which some lead was recovered as a byproduct of the mining and milling of the fluorspar.

Mine production of silver, copper, lead, and zinc in the Central States in 1946, by States, in terms of recovered metals—Continued

State	Copper		Lead		Zinc		Total value
	Pounds	Value	Short tons	Value	Short tons	Value	
Arkansas			2	$436	85	$20,740	$21,176
Illinois			3,865	842,570	8,798	2,146,712	2,991,142
Kansas			6,445	1,405,010	47,703	11,639,532	13,044,542
Kentucky			95	20,710	314	76,616	97,326
Michigan	43,326,000	$7,018,812					7,018,812
Missouri	3,714,000	601,668	139,112	30,326,416	22,234	5,425,096	36,409,256
Oklahoma			13,697	2,985,946	69,552	16,970,688	19,956,634
Wisconsin			1,588	346,184	14,276	3,483,344	3,829,528
Total: 1946	47,040,000	7,620,480	164,804	35,927,272	162,962	39,762,728	83,368,416
1945	67,600,000	9,126,000	201,520	34,661,440	164,225	37,771,750	81,643,729

Mine production of lead and zinc in the Central States in 1946, by regions

Region	Lead [1]		Zinc [2]		Total value
	Short tons	Value	Short tons	Value	
Concentrates:					
Joplin or Tri-State	30,650	$5,038,018	258,705	$30,079,745	$35,117,763
Southeastern Missouri	189,271	21,654,271	1,731	61,147	21,715,418
Upper Mississippi Valley [3]	2,557	377,707	32,930	3,389,297	3,767,004
Kentucky-Southern Illinois	5,687	601,432	8,848	635,795	1,237,227
Central Missouri	130	22,950			22,950
Northern Arkansas	2	236	246	14,232	14,468
Total: 1946	228,297	27,694,614	302,460	34,180,216	61,874,830
1945	284,533	26,400,091	304,289	31,767,675	58,167,766
Recoverable metal:					
Joplin or Tri-State	23,363	5,093,134	139,038	33,925,272	39,018,406
Southeastern Missouri	135,796	29,603,528	451	110,044	29,713,572
Upper Mississippi Valley [3]	1,861	405,698	18,344	4,475,936	4,881,634
Kentucky-Southern Illinois	3,687	803,766	5,044	1,230,736	2,034,502
Central Missouri	95	20,710			20,710
Northern Arkansas	2	436	85	20,740	21,176
Total: 1946	164,804	35,927,272	162,962	39,762,728	75,690,000
1945	201,520	34,661,440	164,225	37,771,750	72,433,190

[1] Includes galena and small quantity of lead carbonate concentrates.
[2] Includes sphalerite and small quantity of zinc carbonate and silicate concentrates.
[3] Region includes Iowa, Northern Illinois, and Wisconsin; no production in Iowa from 1918 to 1946, inclusive.

Quantity and tenor of copper, lead, and zinc ores, old tailings, etc., produced in specified [1] Central States, 1944–46, by States

State	1944		1945		1946	
	Ore, etc.	Metal content [2]	Ore, etc.	Metal content [2]	Ore, etc.	Metal content [2]
	Short tons	*Percent*	*Short tons*	*Percent*	*Short tons*	*Percent*
Kansas	5,229,795	1.54	4,576,379	1.34	4,294,325	1.39
Michigan	5,410,238	.79	5,196,932	.58	4,719,994	.47
Missouri	9,181,092	2.43	8,657,836	2.33	7,501,930	2.25
Oklahoma	13,611,730	.85	12,185,306	.74	12,209,653	.75
Wisconsin	623,811	3.00	957,677	1.81	866,784	2.02
	34,056,666		31,574,130		29,592,686	

[1] Only small-scale intermittent mining done in Arkansas from 1918 to 1946; Kentucky and Illinois excluded because part of the metal output (lead and zinc) was a byproduct of fluorspar mining, and the quantity of metal-bearing material hoisted could not be determined.
[2] The percentages represent metal content of the ore insofar as it is recovered in the concentrates. In Michigan the metal so recovered is copper; in Missouri, copper, lead, and zinc; and in Kansas, Oklahoma, and Wisconsin, lead and zinc. The relative proportions of the metals are shown in the fourth table of this chapter and in tables of tenor of ore given in sections devoted to the respective States.

MINING AND METALLURGIC INDUSTRY

The tonnage of straight copper and lead ores mined in the Central States in 1946 decreased sharply from 1945, but that of zinc and zinc-lead ores increased. The available supply of labor was augmented gradually during the year and nearly balanced demand as the year ended. In some districts this favorable condition did not lead to expansion of actual mining operations. During the war, development was hampered by labor shortage, and the normal ratio of ore developed to that mined was not maintained. When the emergency passed, development work was intensified and the rate of ore extraction adjusted to the point required for economic operation. No important new sources of ore were reported found by exploratory drilling and geophysical investigations carried on outside proved mineralized areas in 1946. The Bureau of Mines and Geological Survey continued to investigate sources of strategic minerals. The work on copper, lead, and zinc included exploratory drilling, geophysical surveys, field examinations, and metallurgical tests.

Most of the mills in the Central States use gravity concentration and flotation. In 1946 flotation concentrates comprised 46 percent of the total copper concentrates (excluding copper-lead flotation concentrates from Missouri), 45 percent of the lead concentrates, and 57 percent of the zinc concentrates produced. Active smelters in the Central States in 1946 were the copper smelter at Hubbell, Mich.; lead smelters at Alton, Ill., Herculaneum, Mo., and Galena, Kans.; and zinc smelters at Bartlesville, Blackwell, and Henryetta, Okla.; Fort Smith, Ark.; and Danville, Depue, East St. Louis (electrolytic plant also), and LaSalle, Ill. One oxide plant at Coffeyville, Kans., two at Hillsboro, Ill., and one at Columbus, Ohio, used raw or roasted concentrates. Smelters at Donora and Josephtown, Pa., and Meadowbrook, W. Va., treated some of the concentrates from the Central States. Six waelz plants, operated in conjunction with zinc smelters in the Central States, treated a total of 172,650 tons of old residues, current residues, carbonate ore, and clean-up material yielding 31,485 tons of oxide averaging 65.38 percent zinc and about 3 percent lead. Most of the oxide was smelted along with concentrates to produce metal.

REVIEW BY STATES

ARKANSAS

Mines in Arkansas produced 246 tons of zinc carbonate concentrates in 1946 compared with 823 tons of carbonate and 29 tons of sulfide in 1945. The output of lead concentrates was 2 tons in 1946 and 1 ton in 1945. The producing zinc mines in 1946 were the Big Hurricane open-pit mine in Searcy County and Mine 16 in Marion County, both equipped with mills. The lead came from the Brewer mine in Newton County.

ILLINOIS

Northern Illinois (see section on Wisconsin for output data).—The Tri-State Zinc, Inc., continued to operate the Gray mine [1] and 600-ton flotation mill south of Galena and in June began operating also the newly developed Bautsch mine. The Gray is opened by two shafts 200 and 278 feet deep. The Bautsch shaft is 282 feet deep. Besides ore from the two mines, the mill treated old tailings from nearby properties. The Big Six (North Unity) and Bennett (South Unity) mines shipped ore to the Vinegar Hill custom flotation mill at Cuba City, Wis. The Ginte mine and jig mill were in production during January and February. The mill was used to re-treat tailings after the mine was closed. The Eagle-Picher Mining & Smelting Co. carried on exploratory drilling north of Galena. The Bureau of Mines continued small-scale exploratory drilling in the area.

Southern Illinois.—The Ozark-Mahoning Co. (formerly Mahoning Mining Co.) operated its fluorspar-zinc-lead mines near Cave in Rock and 320-ton flotation mill at Rosiclare. The producing shafts were the W. L. Davis-Deardorf, W. L. Davis No. 2, East Green, and West Green, which are 311, 146, 230, and 363 feet deep, respectively. The mill handled chiefly company ore but also treated ore, bulk concentrates, and middlings containing zinc, lead, and fluorspar from other mines and mills in Southern Illinois and Kentucky. The mill products were fluorspar concentrates (mostly acid grade), zinc concentrates averaging 62.88 percent zinc, and lead concentrates containing 71.39 percent lead. The Minerva Oil Co. fluorspar-zinc mine and 200-ton flotation mill north of Cave in Rock were operated steadily. The mine is opened by a 645-foot double-compartment shaft and drifts and raises from the 640-foot level. Most of the fluorspar concentrates shipped were of ceramic grade, and the zinc concentrates averaged 63.16 percent zinc. The Alco Lead Corp. operated its open-pit lead mine near Elizabethtown and the remodeled Benson mill. The concentrates comprised roughly two-thirds lead carbonate and one-third lead sulfide; part of them contained some zinc sulfide also. The total output of lead concentrates in Southern Illinois in 1946 was 5,546 tons averaging 66.08 percent lead and yielding 3,592 tons of recoverable lead, 29 tons of zinc, and 2,302 ounces of recoverable silver; zinc concentrates totaled 8,290 tons averaging 62.99 percent zinc and yielding 4,701 tons of recoverable zinc.

KANSAS

The Kansas zinc and lead mines are in the Tri-State (Joplin) mining region, embracing parts of Cherokee County, Kans., and Ottawa County, Okla., and about 12 counties in Southwestern Missouri. General details of the Tri-State mining industry are given in the following pages on Southwestern Missouri.

[1] Zinner, Paul, and Lincoln, Francis Church, Exploration of the Gray and Bautsch Lead and Zinc Deposits, Jo Daviess County, Ill.: Bureau of Mines Rept. of Investigations 3947, 1946, 28 pp.

Mine production of lead and zinc in Kansas, 1942–46

Year	Mines producing	Lead concentrates		Zinc concentrates		Metal content [1]			
						Lead		Zinc	
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1942	81	12,253	$1,167,302	103,247	$6,926,745	9,419	$1,262,146	55,874	$10,392,564
1943	82	12,243	1,473,891	105,656	10,792,583	9,213	1,381,950	56,944	12,299,904
1944	85	12,176	1,418,781	117,827	11,959,317	9,394	1,503,040	63,703	14,524,284
1945	82	9,967	1,236,322	89,305	9,715,271	7,370	1,267,640	48,394	11,130,620
1946	82	8,499	1,388,210	87,963	9,902,906	6,445	1,405,010	47,703	11,639,532

[1] In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the value of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead and zinc ore and old tailings milled and concentrates produced in Kansas, 1945–46

	1945		1946	
	Crude ore	Old tailings	Crude ore	Old tailings
Total ore and old tailings milled ..... short tons	2,693,110	1,883,269	2,980,313	1,314,012
Total concentrates produced:				
Galena ..... do	9,967	----------	8,499	----------
Sphalerite ..... do	83,830	5,475	84,010	3,953
Ratio of concentrates to ore, etc.:				
Lead ..... percent	0.37	----------	0.29	----------
Zinc ..... do	3.11	0.29	2.82	0.30
Metal content of ore, etc.: [1]				
Lead ..... do	.28	----------	.22	----------
Zinc ..... do	1.88	.17	1.70	.18
Average lead content of galena concentrates ..... do	75.42	----------	77.31	----------
Average zinc content of sphalerite concentrates ..... do	60.32	58.54	60.29	59.55
Average value per ton:				
Galena concentrates	$124.04	----------	$163.34	----------
Sphalerite concentrates	107.83	$123.52	112.40	$116.36

[1] Figures represent metal content of the crude ore (or "dirt") only insofar as it is recovered in the concentrates; data on tailing losses not available.

The Baxter Springs-Blue Mound-Treece area contributed 84 percent of the total Kansas output of zinc concentrates and 95 percent of the lead concentrates in 1946. About 36 percent of the crude ore mined in the area was concentrated in the Central mill of the Eagle-Picher Mining & Smelting Co. at Cardin, Okla. Most of the ore was transported to the mill over the Northeast Oklahoma Railroad, which has spur tracks to the principal ore-hoisting shafts. A large producer opened in 1946 was the Eagle-Picher Foley-Mullen mine at Blue Mound. The mine is worked through a new 455-foot shaft (the deepest shaft in the Tri-State district) on the north end of the Foley lease. Other producing Eagle-Picher mines in this area were the Big John, Leopard No. 2, Parmenter, Puterbaugh, Sim C. No. 1, Webber mines, Westside-Foley mines, Wilbur, and Leopard-Youse Slaughter. The company operated the Paxson, Stoskopf, and Swalley "D" mines and the Paxson mill as agent for the Office of Metals Reserve. Diesel truck haulage is being used advantageously in the Paxson mine.[2]

[2] Clarke, S. S., Diesel Truck Haulage at the Paxson Mine: Eng. and Min. Jour., vol. 148, No. 3, March 1947, pp. 54–56.

The St. Louis Smelting & Refining Co. mines near Baxter Springs were large producers; they comprised the Ballard, Clark, English "O", Keith (North 60), Moore, Shanks, Slaughter, and Walter H. The mines are served by the company No. 8 central mill, which also treated custom ore from the Keith (South 20) mine and the C. & M. lease (St. Louis No. 4) in Oklahoma. Other Kansas mines were served by the Beck No. 3, Dines, Youngman, and Wade mills or by mills in Oklahoma. Important producers included the MacArthur mine, Beck (Smith, Swalley), Lula Bell (Liza Jane), Dines (Hartley No. 1, Stoskopf, Tar Creek), C. K. & E. (Stebbins, Karcher), Robinson (Douthit, Jarrett), Harris (E–W. No. 24, Silver Fox), Bilharz (Muncie), Bilwil (Ebenstein), Little Ben (Bendelari), Mark Twain (Blue Mound), Mid-Continent (Wright), and Wade-Rea (Hunter, Hartley).

The Barr Cleanup mill continued active. The Captain mill and the Semple (Martin, in Oklahoma) treated old tailings from Kansas. Stripping operations by F. W. Evans Mines on the old caved Peru mine workings were suspended early in 1946. In November Fred Childress & Sons began sinking a 434-foot shaft on the Vanatta property near Melrose.

At Galena the principal producers were the Eagle-Picher Murphy and the Galena Mining Co. Southside mines, shipping to the Central mill; and the Bonanza, Mess Cave, and Murray-Davis, shipping to mills in Missouri. The Eagle-Picher lead smelter and lead and zinc pigment plant at Galena purchases most of the lead concentrates produced in the Tri-State district. At Peacock the Carson tailing mill operated until it burned March 7.

In the Waco district (Kansas part) the St. Louis Smelting & Refining Co. operated its No. 9 mill on company and custom ore. The Kansas shippers to the mill were the company Barnsdall and Grasselli mines and the Stotts City Mining Co. Oscar Bennett mine. The F. W. Evans Mines operated its mill and the St. Louis and O'Neill mines.

KENTUCKY

The Kentucky output of recoverable zinc in 1946 was 314 tons and lead 95 tons compared with 182 and 129 tons, respectively, in 1945. The K. T. Dome Mining Syndicate operated the Gratz zinc-lead mine and 50-ton mill at Gratz in Owen County. The United States Coal & Coke Co. produced byproduct zinc and lead concentrates in its fluorspar mill at Mexico, Crittenden County. Other fluorspar producers shipped material containing zinc, lead, and fluorspar to the Ozark-Mahoning mill at Rosiclare, Ill.; the principal shippers were the Ozark-Mahoning Mineral Ridge and Babb mines.

MICHIGAN

The mine output of copper in Michigan decreased 29 percent in 1946 from 1945. This drop, following the 28-percent decline in 1945, reduced production to the lowest level since 1879. The Quincy and Copper Range mines, operated until August 1945, were idle throughout 1946. The reclamation plants and all but one of the mines were inoperative from May 11 to June 16 because of the shortage of coal. The average price per pound of fine copper paid for the mine output was 20.48 cents (including Federal premiums) compared with 17.77

cents (including premiums and increment from special prices) in 1945. In 1946 mine mills treated 1,611,579 tons of rock yielding 31,018,000 pounds of fine copper, and reclamation plants handled 3,108,415 tons of old tailings yielding 12,308,000 pounds of copper.

The concentrate ("mineral") produced at mills in Michigan in 1946 was smelted in the Calumet & Hecla smelter at Hubbell; the Copper Range smelter was not run in 1946. None of the copper bullion produced during the year was shipped to electrolytic refineries for recovery of silver, and no silver was reported recovered from tables or jigs in the mills.

Mine production of silver and copper in Michigan, 1942–46 [1]

Year	Silver (fine ounces)	Copper			Concentrate ("mineral")		Crude ore and sands (short tons)
		Pounds	Yield		Pounds	Yield (percent copper)	
			Pounds per ton of crude ore and sands	Percent			
1942	61,674	91,358,000	20.9	1.05	141,372,582	64.6	4,362,640
1943	48,479	93,528,000	21.2	1.06	143,142,155	65.3	4,403,594
1944	54,218	84,842,000	15.7	.78	129,646,181	65.4	5,410,238
1945	21,863	60,802,000	11.7	.58	97,467,825	62.4	5,196,932
1946	----------	43,326,000	9.2	.46	72,179,300	60.0	4,719,994

[1] Figures based upon actual recovery of copper from "mineral" smelted and estimated recovery from "mineral" not smelted during year.

Value of silver and copper produced by Michigan mines, 1942–46

Year	Silver	Copper		Total	Year	Silver	Copper		Total
		Total	Per ton of crude ore and sands				Total	Per ton of crude ore and sands	
1942	$43,857	[1] $11,054,318	[1] $2.53	$11,098,175	1945	$15,547	[1] $8,208,270	[1] $1.58	$8,223,817
1943	34,474	[1] 12,158,640	[1] 2.76	12,193,114	1946	--------	[1] 7,018,812	[1] 1.49	7,018,812
1944	38,555	[1] 11,453,670	[1] 2.12	11,492,225					

[1] Value of copper calculated at average weighted price (including Government bonuses) for all domestic copper sold (see first table of this chapter, footnote 3). If calculated at actual prices paid to Michigan operators, the value of the copper was—1942: $11,722,792, or $2.69 to the ton of crude ore and sands; 1943: $15,139,831, or $3.44 to the ton; 1944: $14,033,131, or $2.59 to the ton; 1945: $10,801,506, or $2.08 to the ton; 1946: $8,871,332, or $1.88 to the ton.

The Calumet and Hecla Consolidated Copper Co. operated its Ahmeek stamp mill, the Lake Linden and Tamarack reclamation plants, and the Ahmeek, Allouez, Centennial, Douglass, Iroquois, North Kearsarge, and Peninsula mines. Ore was also produced in development at the Seneca No. 2 mine, last operated in 1930. The shaft and surface plants were being reconditioned to develop at depth ground overlying the Kearsarge lode adjacent to the Ahmeek mine. The following data are extracted from the annual company report to stockholders. Production the first half of 1946 was hampered by shortage of underground labor and the 36-day shut-down caused by the coal strike. Rock stamped totaled 1,264,836 tons yielding 24,515,-

647 pounds of copper. The output of primary copper from the two reclamation plants totaled 7,255,485 pounds. The Lake Linden plant treated low-grade amygdaloid tailings from the Osceola lode. Because of the gradually decreasing copper content, the current operating cost has risen to 22 cents, the maximum allowed under the Premium Price Plan. The Tamarack plant, operating on amygdaloid tailings from the Kearsarge lode, showed a small profit. The new secondary copper department reached a satisfactory production rate. At the smelter two furnaces were rebuilt. Increased smelting requirements will necessitate erection of another furnace. Exploration by diamond drilling continued throughout the year. The results in the Copper Harbor area were negative, and it was decided to transfer attention to company lands nearer the known ore bodies. The mineral rights were purchased on more than 2,000 acres of the Mayflower-Old Colony land. The exploratory program has added materially to the company's known ore reserves. If the present relationship between copper prices and labor and supply costs is maintained, the mines of the company are assured of many years of productive life.

The Isle Royale Copper Co. operated its mine continuously and produced 16 percent more copper than in 1945. According to the annual company report to stockholders, mining operations consisted entirely of stoping out ore reserves, as no development work was done in 1946. The mill stamped 346,743 tons of rock, with two heads operated most of the time on a 5-day-week basis. The yield of refined copper was 18.754 pounds per ton of rock stamped compared with 18.946 pounds in 1945. Production costs were 19.295 cents per pound of copper delivered. Depletion amounted to 1.3772 cents per pound, making an over-all cost of 20.6722 cents.

The Quincy Mining Co. reclamation plant treated 1,006,415 tons of sands yielding 5,052,515 pounds of fine copper. The Quincy mine, closed August 31, 1945, remained idle throughout 1946. The mine had been operating under a special-price Government contract for copper and was unable to continue operations at the price obtainable under the Premium Price Plan after the contract expired. The annual company report to stockholders for 1945 states that the mine had been in operation nearly 100 years. Copper produced totaled 848,083,134 pounds, and dividends paid amounted to $27,002,500. Mining in recent years was at depths ranging from 8,000 to 9,000 feet on the lode, or at vertical depths ranging from 5,000 to 6,000 feet. The copper contents of the lode continued good at these depths. In discontinuing operations the shaft pillars were not mined, so that it will be necessary only to unwater the mine to resume operations if future conditions make them profitable.

The Copper Range Co. mines, mill, tailing plant, and smelter in Houghton County remained idle throughout 1946. In Ontonagon County the company continued drilling on its White Pine property and sank a 30° inclined shaft. Ore was encountered at a depth of 900 feet, and the shaft was continued to 1,400 feet. A station was cut, and drifting on one level near the bottom of the shaft was progressing as the year ended.

MISSOURI

Missouri has been the chief lead-producing State for the past 39 years and until 1918 had ranked first in zinc production for many years. The principal lead mines are in the Southeastern Missouri region. Silver and copper are recovered as byproducts in smelting lead concentrates produced in this region, and copper and a little silver have been recovered in some years (including 1944–46) from lead-copper-cobalt-nickel-iron ore mined in Madison County. Silver recovered in 1946 totaled 69,401 ounces and copper 1,857 tons compared with 94,822 ounces and 3,399 tons, respectively, in 1945. In the sale of the lead concentrates, no value is attached to the silver and copper, as the quantity recovered per ton of concentrates is very small. The zinc output comes mostly from zinc-lead mines in Southwestern Missouri. The Central district of Missouri had a small output of lead in 1946 and of both zinc and lead in the years 1942–45; the figures are included with those of Southeastern Missouri in the table that follows.

Mine production of lead and zinc in Southeastern and Central Missouri, 1942–46

Year	Lead concentrates (galena)		Zinc concentrates (sphalerite) [1]		Metal content [2]			
					Lead		Zinc	
	Short tons	Value [3]	Short tons	Value	Short tons	Value	Short tons	Value
1942	277,255	$19,426,540	1,739	$41,913	197,432	$26,455,888	[4] 842	$156,612
1943	257,305	18,490,413	2,284	99,710	179,134	26,870,100	[5] 923	199,368
1944	243,279	19,920,200	3,206	112,485	169,962	27,193,920	[6] 1,508	343,824
1945	245,805	21,870,243	1,335	45,706	173,053	29,765,116	[7] 595	136,850
1946	189,401	21,677,221	1,731	61,147	135,891	29,624,238	451	110,044

[1] Includes zinc-lead carbonate concentrates.
[2] In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.
[3] Values given are to a certain extent arbitrary, as part of the lead concentrates are smelted by the producer.
[4] Includes 450 tons recovered from lead-smelter slags.
[5] Includes 360 tons recovered from lead-smelter slags.
[6] Includes 776 tons recovered from lead-smelter slags and byproduct matte from lead smelting.
[7] Includes 240 tons recovered from byproduct matte from lead smelting.

Mine production of lead and zinc in Southwestern Missouri, 1942–46

Year	Lead concentrates				Zinc concentrates				Metal content [1]			
	Galena		Carbonate		Sphalerite		Silicate		Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1942	2,790	$303,331	20	$864	66,881	$4,791,020	1,510	$23,940	2,116	$283,544	35,552	$6,612,672
1943	7,679	908,591	------	------	56,357	5,724,079	1,037	51,261	5,776	866,400	29,490	6,369,840
1944	6,294	752,796	9	855	64,651	6,898,980	2,453	218,017	4,721	755,360	35,118	8,006,904
1945	4,679	635,031	------	------	40,156	4,605,647	606	44,600	3,522	605,784	21,580	4,963,400
1946	4,220	734,676	84	12,067	40,937	4,985,668	332	20,243	3,221	702,178	21,783	5,315,052

[1] In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

Tenor of lead ore and concentrates in Southeastern Missouri disseminated-lead district, 1942–46

	1942	1943	1944	1945	1946
Total lead ore [1] short tons	7,107,191	6,831,377	6,535,874	6,675,767	5,491,239
Galena concentrates in ore percent	3.90	3.76	3.72	3.68	3.44
Average lead content of galena concentrates percent	72.65	70.99	71.02	71.66	73.09
Average value per ton of galena concetrates	$70.04	$71.79	$81.78	$88.95	$114.39

[1] Includes lead-copper ore.

Tenor of lead and zinc ore and old tailings milled and concentrates produced in Southwestern Missouri, 1945–46

	1945		1946	
	Crude ore	Old tailings and slimes	Crude ore	Old tailings and slimes
Total ore, etc., milled short tons	1,482,084	468,923	1,591,437	354,717
Total concentrates produced:				
Lead do	4,674	5	4,302	2
Zinc do	37,404	3,358	38,313	2,956
Ratio of concentrates to ore, etc.:				
Lead percent	0.32	0.001	0.27	0.001
Zinc do	2.52	0.72	2.41	0.83
Metal content of ores, etc.: [1]				
Lead do	0.24	0.001	0.21	0.001
Zinc do	1.49	0.40	1.42	0.46
Average lead content of galena concentrates do	76.81	65.00	76.29	65.75
Average lead content of lead carbonate do	----------	----------	63.10	----------
Average zinc content of sphalerite concentrates do	59.43	56.25	58.90	55.38
Average zinc content of silicates and carbonates do	37.79	----------	31.63	----------
Average value per ton:				
Galena concentrates	$135.77	$92.60	$174.14	$85.50
Lead carbonate concentrates	----------	----------	143.65	----------
Sphalerite concentrates	116.95	89.95	123.27	102.80
Zinc silicates and carbonates	73.60	----------	60.97	----------

[1] Figures represent metal content of the crude ore (or "dirt") only insofar as it is recovered in the concentrates; data on tailing losses not available.

Southeastern and Central Missouri.—The Southeastern Missouri disseminated-lead district produced 135,796 tons of recoverable lead in 1946 compared with 173,005 tons in 1945. The output in 1945 represented 44 percent of the United States total mine production and that in 1946 about 40 percent.

The St. Joseph Lead Co. mines in St. Francois County were the principal producers. Four large groups were operated. The central ore-hoisting shafts and mills (one for each group) are at Bonne Terre, Desloge, Federal (Flat River), and Leadwood. Other shafts are used for men, supplies, and poor rock. The depth of the 15 shafts operated in 1946 ranged from 181 to 755 feet and averaged 430 feet. Development done on the four groups during the year totaled 64,814 feet of drifting, 2,489,903 feet of diamond drilling, and 6,471 feet of churn drilling. The four mills together have a daily capacity of 21,400 tons. Treatment is by table concentration followed by flotation. Operating time was reduced from 6 to 5 days a week April 28. A strike called by the local union October 23, which broke the no-strike 30-year record of the company, caused the loss of 7 working days. Other data extracted from the annual company report to stockholders follow. Wages were increased 18.5 cents an

hour on April 28 and were again increased (12 percent) on November 11, after free market conditions were established and lead prices advanced substantially. Salary adjustments were also made. Lead concentrates produced totaled 166,556 tons with a pig lead equivalent of 113,344 tons compared with 219,241 and 146,395 tons, respectively, in 1945. Reconstruction of the Herculaneum zinc furnace was completed by the year's end, but resumption of slag smelting was postponed until the latter part of March 1947, owing to shortage of power and natural gas during the winter months in the St. Louis area.

In Madison County the principal producer of lead was the Mine La Motte mine, owned by the Mine La Motte Corp. and operated by the St. Joseph Lead Co. The mill has a daily capacity of 1,500 tons. Two shafts 115 and 307 feet deep were operated. Development totaled 4,440 feet of drifts, 40,652 feet of diamond drilling, and 43,597 feet of churn drilling. The Park City Consolidated Mines Co. Ruth mine and 500-ton flotation mill were operated steadily. The mine shaft is 370 feet deep. The Fredericktown Lead Co. operated its 400-ton mill and the Catherine and Fleming mines. The Catherine had one active shaft 71 feet deep and the Fleming two shafts 195 and 112 feet deep. The St. Louis Smelting & Refining Co. produced chiefly lead and lead-copper ore from its Madison group in 1946. Operations on the ore bodies that yield considerable cobalt and nickel were curtailed. Three shafts on the property average about 425 feet in depth. The 600-ton flotation mill made both lead and copper concentrates. In Jefferson County the DeSoto Lead & Zinc Co. mill operated on zinc-lead carbonate ore from the Valle dumps. Companies that did deep exploratory drilling in Washington County announced no conclusive results during the year.

In Central Missouri the D. F. & H. Mining Co. operated the Glover open-pit lead mine and a small Joplin-type mill.

Southwestern Missouri.—The following table, the first four paragraphs, and the charts under this heading pertain to the Tri-State mining industry as a whole; the remaining text reviews mining and milling in Southwestern Missouri only.

The Tri-State district continued in 1946 to be much the largest zinc-producing district in the United States and again ranked third in lead production. A large part of the output came from mines that operated under maximum-price quotas of the Premium Price Plan. Some mines in this group have no developed ore reserves left but, with the aid of premiums, derive ore from undergrade rock removed in drifting out from edges of worked-out ore bodies on feeders (mineralized fractures), ordinarily an exploratory operation.

The weekly quoted price for 60-percent zinc concentrates at Joplin in 1946 was $50 a ton from January 5 to October 26 (except for the weeks ending July 13, 20, and 27, when there was no market), $54 from November 2 to 9, and $64 from November 16 through December 28. The quoted price of lead concentrates was $76.01 a ton from January 5 to June 1, $99.96 the rest of June, $117.96 from July 6 to 20 (no market July 27), $99.90 from August 3 to November 9, $132.30 on November 16, $151.02 from November 23 to December 14, and $160.50 on December 21 and 28 (the highest on record up to that time, but later advances brought the price to $195.65 on March 8, 1947).

Federal premium payments continued on essentially the same basis as in 1945, except that producers who began operating after October 27, 1943, became eligible for the same premiums as old producers. These premiums were: For 60-percent zinc concentrates, $29.70 a ton for assigned production under the A-level quota, $59.40 for B-level, and $89.10 for C-level; for 80-percent lead concentrates, $41.80 for A-level and $83.60 for B-level. In 1946 the maximum B lead premium was expanded an additional $41.80 a ton of concentrates, and an exploration premium of $10.80 a ton for zinc concentrates and $15.20 for lead concentrates was established. After ceiling prices were abolished November 9, premiums were computed on the basis of market prices and were assigned in terms of dollars per ton of concentrates instead of A, B, or C quotas.

Production of lead and zinc concentrates in the Tri-State district (Kansas, Oklahoma, and Southwestern Missouri), 1942–46

FROM CRUDE ORE

Year	Ore, etc., milled (short tons)	Concentrates produced (short tons)		Concentrate recovery (percent)		Average assay of concentrates (percent)		Average value per ton of concentrates	
		Lead	Zinc	Lead	Zinc	Lead	Zinc	Lead	Zinc
1942	8,587,337	44,397	378,751	0.52	4.41	78.35	59.86	$99.55	$68.00
1943	9,430,812	45,941	319.379	.49	3.39	76.68	59.46	121.12	101.72
1944	9,118,388	36,544	301,854	.40	3.31	77.79	59.72	120.47	105.64
1945	7,441,345	31,643	217,790	.43	2.93	75.61	59.96	125.00	110.48
1946	8,271,512	30,468	224,910	.37	2.72	77.40	59.88	164.81	116.15
FROM OLD TAILINGS REMILLED									
1942	10,239,121	460	65,096	0.004	0.64	55.87	57.84	$80.06	$79.10
1943	11,270,106	404	56,857	.004	.50	50.25	57.88	66.42	93.78
1944	12,293,010	390	53,547	.003	.44	51.79	58.26	72.07	98.18
1945	11,271,347	201	41,211	.002	.37	51.24	58.67	69.12	104.97
1946	10,178,620	182	33,795	.002	.33	48.35	58.60	90.85	117.10
DISTRICT TOTAL									
1942	18,826,458	44,857	443,847	0.24	2.36	78.12	59.57	$99.35	$69.63
1943	20,700,918	46,345	376,236	.22	1.82	76.45	59.22	120.65	100.52
1944	21,411,398	36,934	355,401	.17	1.66	77.52	59.50	119.96	104.51
1945	18,712,692	31,844	259,001	.17	1.38	75.45	59.75	124.65	109.60
1946	18,450,132	30,650	258,705	.17	1.40	77.23	59.71	164.37	116.27

About 43 mills were operating in the district in December 1946; 14 were tailing mills, compared with 50 in December 1945, including 16 tailing mills. The mine mills, including those treating custom ore, together served about 183 mines (active all or part of the year) operated by 87 companies and individuals. These mines do not include very small gouges, mill clean-ups, or clean-ups of boulder piles at old shafts; the total producing mines, gouges, and clean-ups was 248 compared with 226 in 1945. The depth of the operating shafts ranged from 45 to 450 feet. Most of the mines and mills were shut down about 3 weeks in July pending reinstatement of the Premium Price Plan, and a few were closed for other short periods by labor strikes. Prospect drilling lagged, but considerable drilling was done to develop extensions of ore bodies. The Bureau of Mines did churn

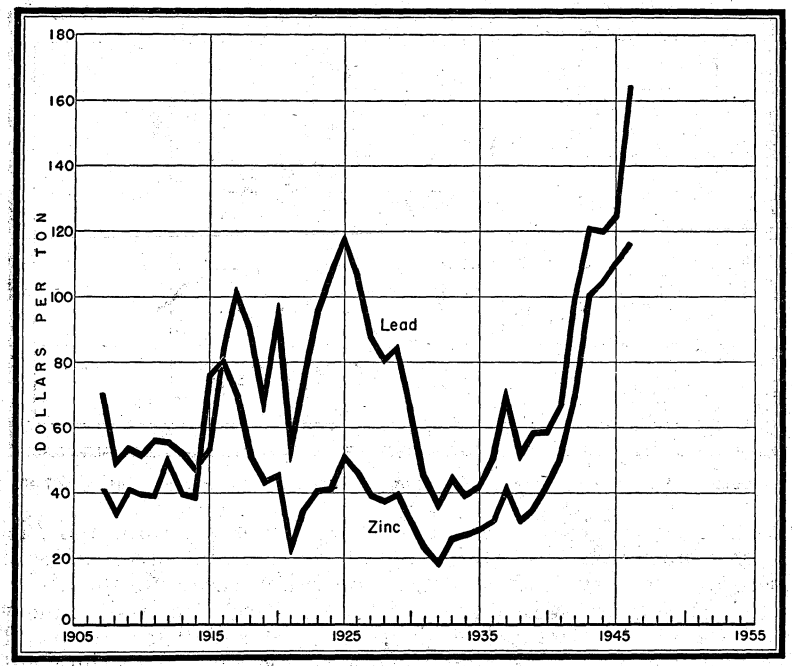

FIGURE 1.—Average prices received by sellers per ton of concentrates in the Tri-State district.

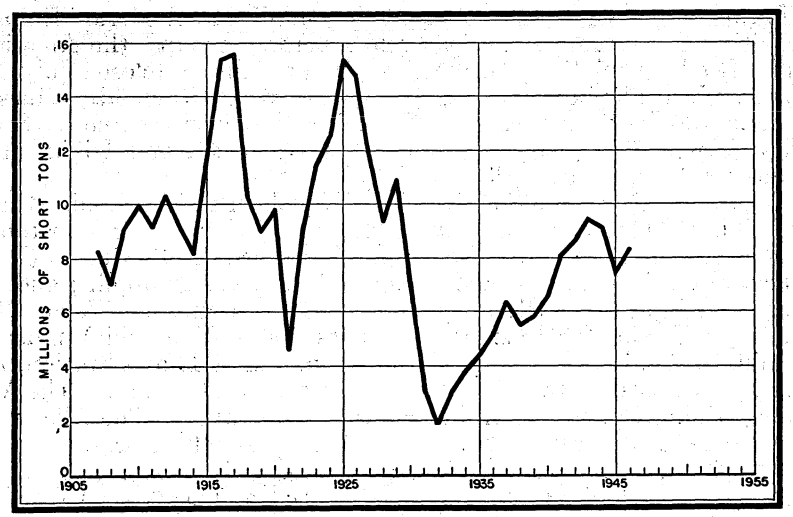

FIGURE 2.—Quantity of crude ore milled in the Tri-State district.

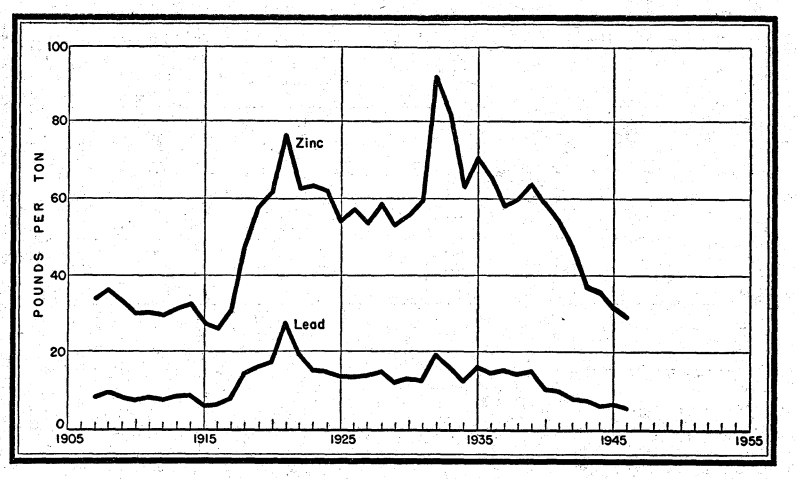

FIGURE 3.—Metal recovered per ton of crude ore (rock) milled in the Tri-State district, 1907-46.

drilling in the Melrose, Galena, Racine, Thoms Station, and Picher (Kansas part) areas. Certain data on drilling and ore reserves and a historic summary of the district production were published.[3]

In Southwestern Missouri the Oronogo Circle open-pit mine was again the largest producer of zinc. The pit is 230 feet deep. The ore is trucked out of the pit and shipped by railroad to the Central Mill. The Eagle-Picher Needmore and the Fenix & Sons Oronogo No. 5 shaft mines shipped ore to the Central Mill. Operating Southwestern Missouri mines equipped with mills included the Fenix & Martin La Tosca at Oronogo; the Kansas Explorations Buckingham-Gibson north of Oronogo and Jasper near Joplin; the Federal Mining & Smelting Co. Granby-American and Duenweg groups; the American Zinc, Lead & Smelting Co. Hunter group at Aurora (closed July 31); the F. W. Evans Sucker Flat; the C. C. Playter (Reynolds) mines at Waco; the Southwest (K. D. F.) silicate-carbonate mine at Stark City (closed April 16); the Kline at Wentworth; and Dividend at Spurgeon (closed in March).

Other producing mines included the Napoleon and St. Louis Mining & Milling Co. group at Thoms Station; the Manning & Winston at Duenweg; the Little Pat, Mattes (Zig Zag), Eureka Producers (Rex), Turkey Creek (Swartz), and Wildwood (Potter) at Joplin; and the Gascho, High Five, Olsen, O'Neill, and St. Louis at Waco. The C. G. & C. Co. (Northside) and Mess Cave (Southside) mills at Joplin, the St. Louis Mining & Milling Co. mill at Thoms Station, and the Magajupa (Sciota) at Webb City treated custom ore. The Missouri Mining Co. tailing mill at Chitwood operated. The Alice mine in Ozark County shipped sorted carbonate and sulfide ores.

[3] Ruhl, Otto, Tri-State Zinc-Lead Ore Reserves: Bureau of Mines Rept. of Investigations 3922, 1946, 7 pp.
Brichta, Louis C., Exploration for Zinc and Lead ore, Phelps Lease, Jasper County, Mo.: Bureau of Mines Rept. of Investigations 3941, 1946, 44 pp.
Brichta, Louis C., Exploration of O'Jack Mining Co. Zinc and Lead Deposits, Jasper County, Mo.: Bureau of Mines Rept. of Investigations 3970, 1946, 39 pp.
Martin, A. J., Summarized Statistics of Production of Lead and Zinc in the Tri-State (Missouri-Kansas-Oklahoma) Mining District: Bureau of Mines Inf. Circ. 7383, 1946, 67 pp.

OKLAHOMA

Mining and milling in the Tri-State region—which includes Northeastern Oklahoma—are discussed in the preceding pages on Southwestern Missouri.

Mine production of lead and zinc in Oklahoma, 1942–46

Year	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Metal content [1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1942	29,794	$2,985,285	272,209	$19,163,622	22,806	$3,056,004	146,510	$27,250,860
1943	26,423	3,208,885	[2] 213,195	21,251,796	19,733	2,959,950	114,085	24,642,360
1944	18,455	2,258,188	170,470	18,067,967	13,944	2,231,040	91,449	20,850,372
1945	17,198	2,097,952	128,934	14,021,165	12,664	2,178,208	69,300	15,939,000
1946	17,847	2,903,065	129,473	15,170,928	13,697	2,985,946	69,552	16,970,688

[1] In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

[2] Includes 58 tons of zinc carbonate averaging 31.03 percent zinc.

Tenor of lead and zinc ore, old tailings, and slimes milled and concentrates produced in Oklahoma, 1945–46

	1945		1946	
	Crude ore	Old tailings and slimes	Crude ore	Old tailings and slimes
Total ore, etc., milled, short tons	3,266,151	8,919,155	3,699,762	8,509,891
Total concentrates produced:				
Galena, do	17,002	196	17,667	180
Sphalerite, do	96,556	32,378	102,587	26,886
Ratio of concentrates to ore, etc.:				
Lead, percent	0.52	0.002	0.48	0.002
Zinc, do	2.96	.36	2.77	.32
Metal content of ore, etc.: [1]				
Lead, do	.39	.001	.38	.001
Zinc, do	1.77	.21	1.66	.19
Average lead content of galena concentrates, do	75.39	51.02	78.62	47.78
Average zinc content of zinc concentrates, do	59.98	58.94	59.91	58.81
Average value per ton:				
Galena concentrates	$122.60	$68.52	$163.40	$90.91
Zinc concentrates	110.54	103.39	116.75	118.78

[1] Figures represent metal content of the crude ore (or "dirt") only insofar as it is recovered in the concentrates; data on tailing losses not available.

The Eagle-Picher Mining & Smelting Co., largest producer of zinc and lead in the Tri-State district, operated its Central mill at Cardin at a higher rate than in 1945. The mill (capacity expanded to 15,000 tons daily) is equipped with differential-density (sink-and-float) preliminary-concentration units, which furnish an enriched product for treatment by jigging and flotation. Of the total ore treated in 1946 (3,496,105 tons), 59 percent came from Oklahoma. Eagle-Picher mines in Oklahoma shipping to the mill were the Blue Goose mines, Buffalo, Crawfish, Douthat, Goodeagle mines, Gordon No. 2, Grace Walker No. 2, Hum-bah-wat-tah mines, John Beaver, Little Greenback, Lotson mines, Netta, Piokee, See Sah No. 3, Slim Jim

(Bankard and Vantage), Southside, Swift, and White. The company also milled a large tonnage of low-grade boulders obtained from waste shaft dumps. Other large Oklahoma shippers to the mill included the Davis Big Chief (Skelton, Imbeau), Federal Mining & Smelting Co. (Lucky Syndicate-Howe, Gordon, Quapaw-Davenport), Mid-Continent (Acme, Wright), F. W. Evans (Shorthorn, Craig), W. M. & W. (Velie), Carpenter (New York-Grace Walker, Oko), C. G. & C. (Lucky Bill), Mahutska (Jeff City-Eudora), Tongaha, Hudson (Bingham), Blue Bird, and Bob White.

Other large producers equipped with mills were the American Zinc No. 7 mine, Cameron & Henderson (Admiralty mine), Marcia K (formerly Lawyers), Rialto, Scott, United Zinc Royal and Park Walton, and Weidman (Woodchuck and Townsite). The Mission mill treated custom ore. The Baird (Harris), C. & M. (St. Louis No. 4), Farmington, Pelican, Quebec-Gray, Toltec, and Waxahachie mines were operated. The Kansas Explorations Ritz mill ran until March, when the mill, shaft derrick, and hopper burned. The derrick and hopper were rebuilt during the year. The M. & W. Mining Co. Brewster-Huttig and Ninety-Six mines shipped ore to the company mill near Baxter Springs, Kans. The Four-Mile (T. R. Smith) mine made a small output.

Operating tailing mills in Oklahoma comprised the Atlas, Big Chief, Britt & Britt, C. G. & C., Cardin Nos. 2, 3, and Western, Evans-Wallower No. 4, Semple (Martin), and Tri-State Zinc Ottawa and Sooner.

WISCONSIN

The Wisconsin zinc- and lead-mining area is in the Upper Mississippi Valley region, which includes adjacent parts of Illinois and Iowa. The Iowa part has had no production since 1917. Since 1942 the Office of Metals Reserve has purchased and stock-piled locally some of the crude ore mined in the region. The metal output from the stock-piled ore is credited to the production of the year in which the ore is milled rather than to the year in which it is mined.

The total regional output of finished (60-percent) zinc concentrates was 32,930 tons and lead concentrates 2,557 tons in 1946, compared with 34,758 and 3,011 tons, respectively, in 1945. The Northern Illinois area produced 7,338 tons of finished zinc concentrates and 367 tons of lead concentrates in 1946 compared with 6,726 and 648 tons, respectively, in 1945; the yield of recoverable metals was 4,068 tons of zinc and 273 tons of lead in 1946, compared with 3,757 and 485 tons, respectively, in 1945. The Wisconsin output from 1942 to 1946 is shown in the following table.

The Vinegar Hill Zinc Co. custom-flotation mill at Cuba City affords a regional market for crude ore and rougher jig zinc-iron-lead sulfide concentrates. The mill produces finished zinc and lead concentrates and also iron concentrates utilized in the adjoining company sulfuric-acid plant. The principal Wisconsin shippers to the mill in 1946 were the Cuba Mining Co. (Andrews mine), Gill Bros. (James), Meloy & Baker (Hoskins, Martin); the C. F. & H. (Mulcahy), New

Lucky Hit (Coughlin, Wilkins), Kittoe, Hofer (Boyle), Thompson, Little Benny (Monroe), Fox (Cottingham), Little Grant, North Star, and Deuce (New Harty) mining companies; Harold Reinke Partnership (Federal), and Whitechurch & Farr (Little Mullen).

Other Wisconsin mills making finished (flotation) concentrates were the Dodgeville Mining Co. mill at Dodgeville (serving the Dodgeville No. 3 and Simpson mines); the W. E. Faithorn mill at New Diggings (Champion mine); the Northwest Zinc Co. tailing mill near Hazel Green; the Chestnut Hill Zinc Co. tailing mill near Shullsburg; and the Coker mill near Livingston. The Coker mill was operated by the United Milling & Mining Co. until August 25, when the company completed running its tailing reserve and ceased operations. The mill was then taken over by the Inland Lead & Zinc Co., which had been developing the Coker and Rundell mines. The new company built a crushing plant on the Rundell property and used it and the Coker flotation mill to treat ore from the two mines.

The Mining Division office of the Bureau of Mines at Platteville, closed early in 1946, was reopened in August, and field investigations were resumed. Drilling in the vicinity of Fairplay began November 19. Data on some of the drilling done in previous years were published.[4]

Mine production of lead and zinc in Wisconsin, 1942–46

Year	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Metal content [1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1942	1,092	[2] $104,896	17,449	[2] $1,028,828	775	$103,850	9,426	$1,753,236
1943	1,307	[2] 111,360	26,632	[2] 1,624,858	920	138,000	14,387	3,107,592
1944	1,954	[2] 166,853	28,696	[2] 1,892,313	1,415	226,400	15,549	3,545,172
1945	2,363	[2] 210,414	28,032	[2] 2,109,877	1,776	305,472	15,561	3,579,030
1946	2,190	[3] 323,550	25,592	[3] 2,730,408	1,588	346,184	14,276	3,483,344

[1] In calculating metal content of the ores from assays allowance has been made for smelting losses of both lead and zinc. In comparing the values of ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.

[2] Most of the finished zinc concentrates and part of the lead concentrates produced in Wisconsin in 1942–45 came from a custom mill treating purchased crude ores and low-grade bulk concentrates on which premium payments had been made previously to mine operators; therefore the value of these concentrates is calculated at market prices. Premium payments not reflected in the value of the finished concentrates amounted to about $399,000 in 1942, $1,059,000 in 1943, $1,384,367 in 1944, and $1,087,243 in 1945 for zinc and $18,500, $40,600, $71,498, and $96,074 respectively, for lead; part of these payments, however, were for ore which was stock-piled.

[3] Includes calculated value of premium payments on ore milled at custom mill.

[4] Lincoln, Francis Church, Exploration of the New Dale Rundell Zinc Mine, Mifflin District, Iowa County, Wis.: Bureau of Mines Rept. of Investigations 3912, 1946, 8 pp.
Lincoln, Francis Church, Exploration of the Defense Zinc Property, Iowa County, Wis.: Bureau of Mines Rept. of Investigations 3948, 1946, 7 pp.
Berliner, M. Howard, Coughlin and Galena Level Zinc Mines Area, LaFayette County, Wis.: Bureau of Mines Rept. of Investigations 4047, 1947, 10 pp.

Tenor of lead and zinc ore and old tailings milled and concentrates produced in Wisconsin, 1945–46

	1945		1946	
	Crude ore	Old tailings	Crude ore	Old tailings
Total ore, etc., milled ..... short tons	338,033	619,644	314,819	551,965
Total concentrates produced:				
Lead ..... do	2,363	----------	2,182	8
Zinc ..... do	23,435	4,597	21,005	4,587
Ratio of concentrates to ore, etc.:[1]				
Lead ..... percent	0.70	----------	0.69	0.001
Zinc ..... do	6.93	0.74	6.67	.83
Metal content of ore, etc.:[2]				
Lead ..... do	.54	----------	.53	.001
Zinc ..... do	4.29	.45	4.15	.51
Average lead content of galena concentrates ..... do	76.77	----------	76.81	50.00
Average zinc content of sphalerite concentrates .. do	61.83	60.93	62.15	61.11
Average value per ton:[3]				
Galena concentrates	$89.05	----------	$147.83	$122.13
Sphalerite concentrates	64.19	$131.73	101.08	132.37

[1] Percentage represents finished flotation concentrates.
[2] Percentages represent metal content of the ore insofar as it is recovered in the concentrates.
[3] Most of the finished zinc concentrates and part of the lead concentrates produced in Wisconsin in 1945 came from a custom mill treating purchased crude ores and low grade bulk concentrates on which premium payments had been made previously to mine operators; therefore, the value of these concentrates is calculated at market prices. Value in 1946 includes premium payments on all ore milled.

Colorado

Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By S. A. GUSTAVSON

	PAGE		PAGE
General summary	1387	Metallurgic industry	1392
Calculation of value of metal production	1388	Review by counties and districts	1396
Mine production by counties	1390	Golden Cycle mill	1402
Mining industry	1391	Leadville district	1404
Ore classification	1392	Cripple Creek district	1410

GENERAL SUMMARY

PRODUCTION of recovered gold increased 41 percent in Colorado in 1946 compared with 1945 but, except for 1943, 1944, and 1945, was the lowest since 1876. The year 1946 marked the first full year of operation of lode and placer gold mines without the restrictions of War Production Board Order L–208 since 1942. There were no important increases in 1946 in the quantities of silver, copper, and zinc recovered from ores mined in Colorado; lead production was virtually the same as in 1945.

Colorado mines in 1946 yielded, in terms of recovered metals, 142,613 fine ounces of gold, 2,240,151 fine ounces of silver, 3,508,000 pounds of copper, 34,072,000 pounds of lead, and 72,294,000 pounds of zinc, the total valued at $19,903,509, a 19-percent increase over 1945. Comparing 1946 with 1945, gold increased 41 percent in quantity and value; silver increased less than 1 percent in quantity and 14 percent in value; copper increased 18 percent in quantity and 42 percent in value; lead production was virtually the same, but the value increased about 27 percent; and zinc increased 1 percent in quantity and 7 percent in value. Of the total value of these five metals, zinc represented 44 percent, gold 25 percent, lead 19 percent, silver 9 percent, and copper 3 percent.

Seven counties in Colorado produced over $1,000,000 in value of the five metals; in order of output, they were: Eagle, Lake, San Miguel, San Juan, Teller, Dolores, and Summit.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices:

Prices of gold, silver, copper, lead, and zinc, 1942–46

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1942	$35.00	$0.711+	$0.121	$0.067	$0.093
1943	35.00	.711+	.130	.075	.108
1944	35.00	.711+	.135	.080	.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] Treasury buying price for newly mined silver. 1942 to June 30, 1946: $0.71111111; July 1, 1946 to Dec. 31, 1946: $0.905.
[3] Yearly average weighted price of all grades of primary metal sold by producers; price includes bonus payments by Office of Metals Reserve for over-quota production.

Annual figures for the 5 years ended with 1946 and total production from 1858 are given in the table that follows. Colorado is second in the production of silver and gold, having yielded first place in the production of silver to Montana in 1942; California is the leading gold producer.

Mine production of gold, silver, copper, lead, and zinc in Colorado, 1942–46, and total, 1858–1946, in terms of recovered metals

Year	Mines producing		Ore sold or treated (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1942	311	68	1,797,386	268,627	$9,401,945	3,096,211	$2,201,750
1943	235	17	1,631,318	137,558	4,814,530	2,664,142	1,894,501
1944	196	13	1,550,422	111,455	3,900,925	2,248,830	1,599,168
1945	195	41	1,357,551	100,935	3,532,725	2,226,780	1,583,488
1946	235	28	1,463,496	142,613	4,991,455	2,240,151	1,810,042
1858–1946			[1]	39,057,943	860,904,969	730,426,678	567,570,125

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1942	2,204,000	$266,684	30,362,000	$2,034,254	64,430,000	$5,991,990	$19,896,623
1943	2,056,000	267,280	36,064,000	2,704,800	88,188,000	9,524,304	19,205,415
1944	2,096,000	282,960	35,396,000	2,831,680	79,910,000	9,109,740	17,724,473
1945	2,970,000	400,950	34,088,000	2,931,568	71,546,000	8,227,790	16,676,521
1946	3,508,000	568,296	34,072,000	3,713,848	72,294,000	8,819,868	19,903,509
1858–1946	[2] 250,711	66,285,369	[2] 2,461,882	238,911,863	[2] 1,339,198	203,260,388	1,936,932,714

[1] Figure not available.
[2] Short tons.

Gold.—Colorado mines yielded 142,613 ounces of gold in 1946 compared with 100,935 ounces in 1945. The principal gold-producing districts were: Cripple Creek in Teller County, which produced 34 percent of the State total gold output; Upper San Miguel in San Miguel County, 17 percent; Fairplay and Tarryall districts in Park County, 13 percent; Animas in San Juan County, 11 percent; and California (Leadville) in Lake County, 8 percent. Dry and siliceous ores yielded 74 percent of the State total gold; placers, 14 percent; zinc-lead ore, 9 percent; and zinc, lead, copper, and lead-copper ores, 3 percent.

Gold and silver produced at placer mines in Colorado, 1942–46, in fine ounces, in terms of recovered metals [1]

Year	Small-scale hand methods [2]		Hydraulic		Gravel mechanically handled						Total	
					Nonfloating washing plants [3]		Dragline dredges		Connected-bucket dredges			
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1942	317	70	63	15	1,541	259	6,173	945	14,523	2,913	22,617	4,202
1943	44	9	36	8	403	60	------	------	38	13	521	90
1944	66	8	28	8	249	74	------	------	------	------	343	90
1945	147	35	49	11	409	72	------	------	7,296	1,277	7,901	1,395
1946	89	15	------	------	1,047	169	(4)	(4)	[4] 19,036	[4] 3,514	20,172	3,698

[1] Nomenclature of methods revised to conform with tables of other State chapters.
[2] Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long toms, dip boxes, pans, rockers, dry washers, etc.
[3] Includes all placer operations using power excavator and washing plant, both on dry land; when washing plant is movable, outfit is termed "dry-land dredge."
[4] Production by dragline dredges included with that by connected-bucket dredge; Bureau of Mines not at liberty to publish separately.

Silver.—The output of silver increased from 2,226,780 ounces in 1945 to 2,240,151 ounces in 1946. The leading silver-producing districts were: Upper San Miguel in San Miguel County, which produced 16 percent of the State total silver; Creede in Mineral County, 16 percent; Animas in San Juan County, 15 percent; California (Leadville) in Lake County, 15 percent; and Pioneer in Dolores County, 8 percent. Dry and siliceous ores yielded 58 percent of the State total silver; zinc-lead ore, 33 percent; zinc ore, 5 percent; and lead, copper, and lead-copper ores and placers, 4 percent.

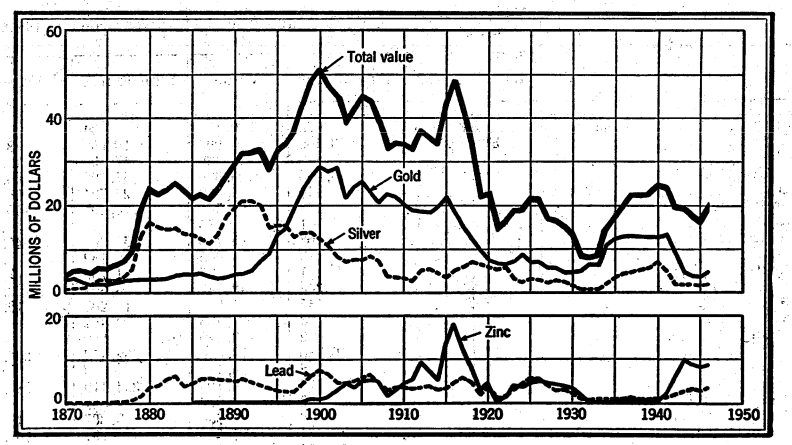

FIGURE 1.—Value of mine production of gold, silver, lead, and zinc and total value of gold, silver, copper, lead, and zinc in Colorado, 1870–1946. The value of copper has been less than $2,000,000 annually, except in a few years.

Copper.—The output of recovered copper from mines in Colorado in 1946 was 3,508,000 pounds compared with 2,970,000 pounds in 1945. Most of the copper produced in Colorado is recovered as a byproduct from ores mined for zinc, lead, or precious metal content; the exceptions are the ores from the Cashin mine in Montrose County,

the Malachite mine in Jefferson County, and the Idarado Mining Co. in San Miguel County—the latter makes a copper concentrate from its complex gold-silver-copper-lead-zinc ore. Dry and siliceous ores yielded 59 percent of the State total copper; zinc-lead ore, 24 percent; copper ore, 13 percent; and zinc, lead, and lead-copper ores, 4 percent.

Lead.—The mine production of recovered lead in Colorado was 34,072,000 pounds in 1946 compared with 34,088,000 pounds in 1945. The California (Leadville) district, Lake County, continued to be the largest producing area in the State and accounted for 26 percent of the State total lead. Other important producing districts included the Animas in San Juan County, 19 percent; Upper San Miguel in San Miguel County, 14 percent; and Pioneer in Dolores County, 13 percent. Zinc-lead ore yielded 54 percent of the State total lead; dry and siliceous ores, 37 percent; zinc ore, 6 percent; and lead, copper, and lead-copper ores, 3 percent.

Zinc.—The output of recovered zinc from mines in Colorado increased from 71,546,000 pounds in 1945 to 72,294,000 pounds in 1946. The principal zinc-producing districts in 1946, in order of output, were: Red Cliff, California (Leadville), Pioneer, Ten Mile, Upper San Miguel, Animas, and Breckenridge. These seven districts produced 91 percent of the State total output in 1946. Zinc ore yielded 53 percent of the State total zinc; zinc-lead ore, 38 percent; and dry and siliceous ores, 9 percent.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1946, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Adams		3	576	$20,160	94	$76
Boulder	31		3,400	119,000	10,052	8,122
Chaffee	5	1	412	14,420	17,196	13,894
Clear Creek	21	1	3,696	129,360	82,792	66,896
Custer	5		40	1,400	25,724	20,785
Dolores	3		136	4,760	173,297	140,024
Douglas		1	1	35		
Eagle	4		164	5,740	57,364	46,350
Fremont	4		19	665	2,182	1,763
Garfield	1		1	35	1,756	1,419
Gilpin	9	8	348	12,180	3,334	2,694
Gunnison	7		145	5,075	15,203	12,284
Hinsdale	1		3	105	442	357
Jefferson	1	3	92	3,220	850	687
Lake	28	1	10,780	377,300	332,472	268,637
La Plata	4		548	19,180	360	291
Mineral	7		175	6,125	355,110	286,929
Montezuma	1		142	4,970	344	278
Montrose	1	1	18	630	23,307	18,832
Ouray	9		8,504	297,640	194,297	156,992
Park	8	7	20,088	703,080	15,995	12,924
Pitkin	2		1	35	41,630	33,637
Rio Grande	1		1,834	64,190	2,338	1,889
Routt	1				63	51
Saguache	7		57	1,995	28,396	22,944
San Juan	15		17,396	608,860	361,328	291,953
San Miguel	11		24,730	865,550	358,443	289,622
Summit	23	2	1,667	58,345	128,246	103,623
Teller	25		47,640	1,667,400	7,536	6,089
Total: 1946	235	28	142,613	4,991,455	2,240,151	1,810,042
1945	195	41	100,935	3,532,725	2,226,780	1,583,488

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1946, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Adams							$20,236
Boulder	8,000	$1,296	136,000	$14,824			143,242
Chaffee	78,000	12,636	47,000	5,123	722,000	$88,084	134,157
Clear Creek	38,000	6,156	941,000	102,569	780,000	95,160	400,141
Custer	9,000	1,458	445,000	48,505	356,000	43,432	115,580
Dolores	223,000	36,126	4,351,000	474,259	6,870,000	838,140	1,493,309
Douglas							35
Eagle	17,000	2,754	1,380,000	150,420	32,873,000	4,010,506	4,215,770
Fremont	30,000	4,860	36,000	3,924	226,000	27,572	38,784
Garfield			35,000	3,815	110,000	13,420	18,689
Gilpin	5,000	810	118,000	12,862	57,000	6,954	35,500
Gunnison	40,000	6,480	778,000	84,802	885,000	107,970	216,611
Hinsdale	4,000	648					1,110
Jefferson	83,000	13,446					17,353
Lake	195,000	31,590	8,883,000	968,247	11,992,000	1,463,024	3,108,798
La Plata							19,471
Mineral	61,000	9,882	492,000	53,628	6,000	732	357,296
Montezuma							5,248
Montrose	292,000	47,304					66,766
Ouray	199,000	32,238	1,743,000	189,987	1,247,000	152,134	828,991
Park	17,000	2,754	122,000	13,298	683,000	83,326	815,382
Pitkin			215,000	23,435	18,000	2,196	59,303
Rio Grande	14,000	2,268					68,347
Routt					14,000	1,708	1,759
Saguache	86,000	13,932	478,000	52,102	480,000	58,560	149,533
San Juan	757,000	122,634	7,084,000	772,156	3,757,000	458,354	2,253,957
San Miguel	1,321,000	214,002	4,762,000	519,058	3,925,000	478,850	2,367,082
Summit	31,000	5,022	2,026,000	220,834	7,293,000	889,746	1,277,570
Teller							1,673,489
Total: 1946	3,508,000	568,296	34,072,000	3,713,848	72,294,000	8,819,868	19,903,509
1945	2,970,000	400,950	34,088,000	2,931,568	71,546,000	8,227,790	16,676,521

Mine production of gold, silver, copper, lead, and zinc in Colorado, in 1946, by months, and in terms of recovered metals

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
January	9,520	160,273	306,000	2,426,000	5,906,000
February	9,389	187,177	240,000	2,990,000	6,440,000
March	11,914	184,589	266,000	2,908,000	7,076,000
April	10,385	153,722	290,000	2,524,000	5,696,000
May	12,194	171,774	276,000	3,160,000	6,290,000
June	11,515	164,033	258,000	3,262,000	6,114,000
July	11,258	179,903	336,000	2,966,000	5,148,000
August	12,473	312,116	272,000	3,142,000	5,540,000
September	12,178	227,958	298,000	2,228,000	5,354,000
October	13,384	156,936	336,000	2,480,000	5,690,000
November	13,890	165,175	320,000	2,966,000	6,380,000
December	14,513	176,495	310,000	3,020,000	6,660,000
Total: 1946	142,613	2,240,151	3,508,000	34,072,000	72,294,000
1945	100,935	2,226,780	2,970,000	34,088,000	71,546,000

MINING INDUSTRY

The nonferrous metal-mining industry in Colorado in 1946 continued to operate for most of the year at about the same rate as in the last part of 1945. Shipments of ores and concentrates from several properties commencing or resuming operations in 1946 were not begun until late in the year and accounted for much of the increased production for the State in November and December.

During 1946 skilled labor continued to be scarce, but common labor became comparatively plentiful. Materials and supplies were still difficult to obtain. Metal prices, except for gold, increased, as did costs of material and labor. The Premium Price Plan for copper, lead, and zinc ended June 30, along with price control. There was no price control from July 1 to July 25, when the President signed a new law effective July 26. Also on July 25 the President signed a new Premium Price Plan for copper, lead, and zinc (expiring June 30, 1947); this plan was retroactive to July 1, 1946.

ORE CLASSIFICATION

Details of ore classification are given in the Gold and Silver chapter of this volume.

Ore sold or treated in Colorado in 1946, with content in terms of recovered metals

Source	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	507,997	72,494	156,857	359,107	2,188,398	1,180,554
Dry and siliceous gold-silver ore	293,907	33,210	637,283	1,616,439	9,132,883	5,340,561
Dry and siliceous silver ore	39,829	303	496,583	91,336	1,139,018	318,315
	841,733	106,007	1,290,723	2,066,882	12,460,299	6,839,430
Copper ore	8,292	131	36,286	466,901	12,249	----------
Lead ore	19,307	1,880	39,911	26,980	1,089,123	----------
Lead-copper ore	5	3	77	346	879	----------
Zinc ore	172,320	2,093	117,607	109,206	1,954,179	38,372,396
Zinc-lead ore	421,839	12,327	751,849	837,685	18,555,271	27,082,174
	621,763	16,434	945,730	1,441,118	21,611,701	65,454,570
Total lode mines	1,463,496	122,441	2,236,453	3,508,000	34,072,000	72,294,000
Placers	----------	20,172	3,698	----------	----------	----------
Total: 1946	1,463,496	142,613	2,240,151	3,508,000	34,072,000	72,294,000
1945	1,357,551	100,935	2,226,780	2,970,000	34,088,000	71,546,000

METALLURGIC INDUSTRY

Of the 1,463,496 tons of ore mined in 1946 in Colorado, 1,077,577 tons (73 percent) were treated at concentrating mills and 360,750 tons (25 percent) at amalgamation and cyanidation mills with concentrating equipment; 25,169 tons (2 percent) were shipped crude to smelters. Colorado has no zinc smelters, consequently all zinc concentrates produced were shipped out of the State; markets for these concentrates were had at Amarillo and Dumas, Tex., Depue, Ill., Palmerton, Pa., and Anaconda and Great Falls, Mont. The Arkansas Valley lead bullion-leady copper matte smelter at Leadville purchased most of the siliceous gold-silver and lead concentrates and silver, lead-copper, and lead ores shipped to smelters during the year; the Golden Cycle mill at Colorado Springs offered a market for nearly all the gold ores shipped for treatment. Smelters and custom mills in the Salt Lake Valley, Utah, continued to be important as a market for Colorado zinc-lead ores and concentrates.

The destination and treatment of concentrates and ores produced by operators in the State are discussed in the following review by counties and districts.

Mine production of metals in Colorado in 1946, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore and concentrates amalgamated	342,976	21,519	4,769			
Sands and slimes cyanided	[1] 305,735	39,802	9,553			
Concentrates smelted	134,720	57,594	2,080,460	3,071,718	32,715,026	72,240,512
Ore smelted	25,169	3,526	141,671	436,282	1,356,974	53,488
Placer		20,172	3,698			
Total: 1946		142,613	2,240,151	3,508,000	34,072,000	72,294,000
1945		100,935	2,226,780	2,970,000	34,088,000	71,546,000

[1] Comprises 303,777 tons of sands and slimes from ore first roasted and amalgamated and 1,958 tons of selective-flotation tailings.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Colorado in 1946, in terms of recovered metals

BY COUNTIES

	Ore treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal					
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Boulder	4,595	2,130	2,045						
Chaffee	20	2	1	2	2	6		478	
Clear Creek	3,136	2,002	680	66	257	3,709	300	4,398	
Gilpin	1,817	46	40	34	32	176			
Gunnison	1,265	77	56	5	6	22		200	
Lake	19,859	59	824	493	57	12,385	3,616	158,408	226,431
La Plata	2	11							
Montezuma	801	108	33	14	34	311			
Ouray	25,677	4,715	1,354	2,803	3,639	122,485	170,000	933,000	806,300
Rio Grande	4,275	250	8	424	1,584	2,330	14,000		
San Miguel	402	[1] 4,266	[1] 1,741						
Summit	25	15	4						
Teller	298,876	47,640	7,536						
Total: 1946	360,750	61,321	14,322	3,841	5,611	141,424	187,916	1,096,484	1,032,731
1945	544,450	35,589	18,856	20,132	5,107	351,317	422,139	4,652,604	9,769,100

BY CLASSES OF ORE TREATED

Dry and siliceous gold	315,165	56,531	11,843	545	1,915	6,554	14,300	5,076	
Dry and siliceous gold-silver	25,853	4,766	1,670	2,814	3,649	122,544	170,154	934,202	806,300
Zinc-lead	19,732	24	809	482	47	12,326	3,462	157,206	226,431
Total 1946	360,750	61,321	14,322	3,841	5,611	141,424	187,916	1,096,484	1,032,731

[1] Includes 4,109 ounces of gold and 1,698 ounces of silver recovered from amalgamating 200 tons of concentrates caught in gold traps of flotation mills.

Mine production of metals from concentrating mills in Colorado in 1946, in terms of recovered metals

BY COUNTIES

	Ore treated (short tons)	Concentrates smelted and recovered metal: Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Boulder	14,443	242	139	4,498	6,600	122,278	
Chaffee	3,361	892	40	9,547	26,914	38,132	722,000
Clear Creek	32,713	3,016	1,321	77,728	35,498	921,448	780,000
Custer	3,842	709	37	19,384	8,710	263,134	356,000
Dolores	35,882	11,021	136	173,297	223,000	4,351,000	6,870,000
Eagle	144,639	38,785	122	53,289	9,746	1,376,958	32,873,000
Fremont	1,848	281	11	1,357	19,028	24,400	216,000
Garfield	707	198	1	1,756		35,000	110,000
Gilpin	4,414	396	225	2,994	4,800	117,100	57,000
Gunnison	4,264	1,790	25	12,781	39,900	669,600	885,000
Jefferson	3,100	167	86	849	83,000		
Lake	292,880	27,000	9,368	284,033	180,620	8,195,780	11,765,569
Mineral	15,552	1,459	124	338,261	60,821	380,309	6,000
Ouray	6,567	1,318	149	69,911	28,894	789,618	440,700
Park	4,245	897	931	5,390	11,938	107,132	683,000
Pitkin	5,180	196		38,974		131,525	6,703
Routt	54	21		63			14,000
Saguache	3,943	769	35	15,211	40,305	293,032	447,809
San Juan	242,714	13,107	17,394	360,654	753,105	7,052,888	3,757,000
San Miguel	208,403	17,457	20,464	356,691	1,321,000	4,761,600	3,925,000
Summit	48,826	11,158	1,375	112,368	29,923	1,987,608	7,293,000
Total: 1946	1,077,577	130,879	51,983	1,939,036	2,883,802	31,618,542	71,207,781
1945	784,093	109,006	50,075	1,742,164	2,027,075	27,318,447	61,740,300
BY CLASSES OF ORE TREATED							
Dry and siliceous gold	191,762	5,675	12,759	133,680	342,268	2,150,089	1,180,554
Dry and siliceous gold-silver	266,495	21,788	24,632	499,072	1,437,557	8,118,984	4,534,261
Dry and siliceous silver	26,589	2,285	155	440,103	82,065	783,352	307,018
Copper	3,100	167	86	849	83,000		
Lead	15,898	375	21	15,904	8,919	320,084	
Zinc	172,320	46,210	2,093	117,607	109,206	1,954,179	38,372,396
Zinc-lead	401,413	54,379	12,237	731,821	820,787	18,291,854	26,813,552
Total 1946	1,077,577	130,879	51,983	1,939,036	2,883,802	31,618,542	71,207,781

Gross metal content of concentrates produced from ores mined in Colorado in 1946, by classes of concentrates smelted

Class of concentrates	Concentrates produced (short tons)	Gross metal content: Gold (fine ounces)	Silver (fine ounces)	Copper (wet assay) (pounds)	Lead (wet assay) (pounds)	Zinc (pounds)
Dry gold	1,473	2,645	10,510	32,105	13,577	1,510
Dry gold-silver	141	65	2,822	2,732	9,365	
Copper	1,963	5,344	47,119	1,045,228	90,533	130,423
Lead	35,487	22,611	1,476,523	904,135	27,960,307	4,138,676
Lead-copper	5,089	10,732	209,843	712,095	2,796,955	593,877
Dry iron [1]	5,611	5,861	35,066	37,210	756,586	335,979
Dry iron-lead [2]	2,089	3,401	19,395	9,947	365,969	134,729
Total to copper and lead plants	51,853	50,659	1,801,278	2,743,452	31,993,292	5,335,194
Zinc	79,767	4,303	210,369	653,027	1,613,032	79,264,080
Zinc-lead	3,100	3,794	126,070	202,976	1,074,773	1,195,599
Total to zinc plants	82,867	8,097	336,439	856,003	2,687,805	80,459,679
Total: 1946	134,720	58,756	2,137,717	3,599,455	34,681,097	85,794,873
1945	129,138	56,484	2,169,184	2,925,612	34,010,869	86,366,502

[1] From zinc-lead ore, silver ore, and gold ore.

[2] From zinc ore.

Mine production of metals from Colorado concentrates shipped to smelters in 1946, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Boulder	242	139	4,498	6,600	122,278	
Chaffee	894	42	9,553	26,914	38,610	722,000
Clear Creek	3,082	1,578	81,437	35,798	925,846	780,000
Custer	709	37	19,384	8,710	263,134	356,000
Dolores	11,021	136	173,297	223,000	4,351,000	6,870,000
Eagle	38,785	122	53,289	9,746	1,376,958	32,873,000
Fremont	281	11	1,357	19,028	24,400	216,000
Garfield	198	1	1,756		35,000	110,000
Gilpin	430	257	3,170	4,800	117,100	57,000
Gunnison	1,795	31	12,803	39,900	669,800	885,000
Jefferson	167	86	849	83,000		
Lake	27,493	9,425	296,418	184,236	8,354,188	11,992,000
Mineral	1,459	124	338,261	60,821	380,309	6,000
Montezuma	14	34	311			
Ouray	4,121	3,788	192,396	198,894	1,722,618	1,247,000
Park	897	931	5,390	11,938	107,132	683,000
Pitkin	196		38,974		131,525	6,703
Rio Grande	424	1,584	2,330	14,000		
Routt	21		63			14,000
Saguache	769	35	15,211	40,305	293,032	447,809
San Juan	13,107	17,394	360,654	753,105	7,052,888	3,757,000
San Miguel	17,457	20,464	356,691	1,321,000	4,761,600	3,925,000
Summit	11,158	1,375	112,368	29,923	1,987,608	7,293,000
Total: 1946	134,720	57,594	2,080,460	3,071,718	32,715,026	72,240,512
1945	129,138	55,182	2,093,481	2,449,214	31,971,051	71,509,400

BY CLASSES OF CONCENTRATES SMELTED

Dry gold	1,473	2,645	10,510	25,590	12,987	1,093
Dry gold-silver	141	65	2,822	2,000	9,000	
Copper	1,963	5,344	47,119	1,012,545	76,953	
Lead	35,487	22,611	1,476,523	721,449	26,708,727	438,748
Lead-copper	5,089	10,732	209,843	567,815	2,737,690	1,258
Dry iron [1]	5,611	5,861	35,066	30,101	715,477	102,591
Dry iron-lead [2]	2,089	3,401	19,395	6,963	351,330	
Total to copper and lead plants	51,853	50,659	1,801,278	2,366,463	30,612,164	543,690
Zinc	79,767	3,141	153,112	532,451	1,046,798	70,830,327
Zinc-lead	3,100	3,794	126,070	172,804	1,056,064	866,495
Total to zinc plants	82,867	6,935	279,182	705,255	2,102,862	71,696,822
Total 1946	134,720	57,594	2,080,460	3,071,718	32,715,026	72,240,512

[1] From zinc-lead ore, silver ore, and gold ore. [2] From zinc ore.

Gross metal content of Colorado crude ore shipped to smelters in 1946, by classes of ore

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	1,070	1,289	4,780	3,278	34,702	
Dry and siliceous gold-silver ore	1,559	163	13,997	11,039	82,934	
Dry and siliceous silver ore	13,240	148	56,480	11,907	372,357	22,783
Copper ore	5,192	45	35,437	391,902	20,392	
Lead ore	3,409	1,859	24,007	22,683	800,834	22,392
Lead-copper ore	5	3	77	432	916	
Total to copper and lead plants	24,475	3,507	134,778	441,241	1,312,135	45,175
Zinc-lead ore to zinc plants	694	19	6,893	15,976	109,577	57,802
Total: 1946	25,169	3,526	141,671	457,217	1,421,712	102,977
1945	29,008	2,263	113,048	544,786	2,236,181	47,570

Mine production of metals from Colorado crude ore shipped to smelters in 1946, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Boulder	139	1,131	3,509	1,400	13,722	
Chaffee	481	11	7,591	51,086	8,390	
Clear Creek	74	114	675	2,202	15,154	
Custer	932	3	6,340	290	181,866	
Eagle	204	42	4,075	7,254	3,042	
Fremont	204	8	825	10,972	11,600	10,000
Gilpin	14	8	118	200	900	
Gunnison	168	37	2,344	100	108,200	
Hinsdale	11	3	442	4,000		
Lake	10,372	1,276	35,227	10,764	528,812	
La Plata	44	537	360			
Mineral	480	51	16,849	179	111,691	
Montrose	4,414	16	23,307	292,000		
Ouray	50	1	547	106	20,382	
Park	410	88	7,084	5,062	14,868	
Pitkin	3,240	1	2,656		83,475	11,297
Saguache	1,060	22	13,185	45,695	184,968	32,191
San Juan	127	2	674	3,895	31,112	
San Miguel	1		11		400	
Summit	2,744	175	15,852	1,077	38,392	
Total: 1946	25,169	3,526	141,671	436,282	1,356,974	53,488
1945	29,008	2,263	113,048	520,786	2,116,949	36,000

BY CLASSES OF ORE

Dry and siliceous gold ore	1,070	1,289	4,780	2,539	33,233	
Dry and siliceous gold-silver ore	1,559	163	13,997	8,728	79,697	
Dry and siliceous silver ore	13,240	148	56,480	9,271	355,666	11,297
Copper ore	5,192	45	35,437	383,901	12,249	
Lead ore	3,409	1,859	24,007	18,061	769,039	
Lead-copper ore	5	3	77	346	879	
Total to copper and lead plants	24,475	3,507	134,778	422,846	1,250,763	11,297
Zinc-lead ore to zinc plants	694	19	6,893	13,436	106,211	42,191
Total 1946	25,169	3,526	141,671	436,282	1,356,974	53,488

REVIEW BY COUNTIES AND DISTRICTS

ADAMS COUNTY

Gold and silver were recovered in 1946 as byproducts from gravel washed for concrete aggregate by W. B. Kerkling from the Brannan Sand & Gravel Co. pit No. 10 near Lakewood, and by Kerkling & Slensker from the Superior Sand & Gravel Co. pit near Lakewood.

BOULDER COUNTY

Central (Jamestown) District.—All the recovered copper and lead, 81 percent of the silver, and much of the gold produced in the district in 1946 were recovered as byproducts in the beneficiation of fluorspar ore by the Ozark-Mahoning Co. (formerly Mahoning Mining Co.). The Smuggler mine of the Smuggler Mining & Milling Co. was operated throughout 1946 by the Smuggler Lease; 667 tons of ore containing 614 ounces of gold and 800 ounces of silver were produced. The John Jay mine was operated throughout 1946 by Ellen McNaughton & Earl Craig; 429 tons of ore containing 418 ounces of gold and 30 ounces of silver were produced. The Last Chance mine was operated by lessees from March 18 to December 31; 51 tons of gold ore were produced.

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1946, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ores sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Adams County		3			576	576		94	94				$20,236
Boulder County:													
Central (Jamestown)	4		15,330	936		936	4,126		4,126	6,500	118,000		50,009
Gold Hill	9		2,467	1,716		1,716	3,239		3,239	300	16,900		64,568
Grand Island	4		118	24		24	1,479		1,479	200	1,100		2,187
Magnolia	2		95	22		22	93		93				845
Sugar Loaf	10		1,115	656		656	1,026		1,026	400			23,854
Ward	2		52	46		46	89		89	600			1,779
Chaffee County:													
Chalk Creek	1		6				10		10		1,100	1,100	262
Granite	2	1	22	10	357	367	21	51	72		600		12,968
Monarch	2		3,834	45		45	17,114		17,114	78,000	45,300	720,900	120,927
Clear Creek County:													
Alice	1		120	8		8	20		20		300		329
Argentine	2		3,797	184		184	4,292		4,292	4,600	295,000	13,000	44,394
Empire	2		783	294		294	162		162	6,800	400		11,567
Griffith	3		9,769	48		48	52,911		52,911	6,300	405,700	615,000	164,704
Idaho Springs	10	1	19,639	2,779	2	2,781	11,683		11,683	14,400	58,600	14,000	117,203
Montana	1		1,200	8		8	11,344		11,344	1,200	46,000	30,000	18,314
Trail	2		615	373		373	2,380		2,380	4,700	135,000	108,000	43,630
Custer County: Hardscrabble	5		4,774	40		40	25,724		25,724	9,000	445,000	356,000	115,580
Dolores County: Pioneer	3		35,882	136		136	173,297		173,297	223,000	4,351,000	6,870,000	1,493,309
Douglas County		1			1	1							35
Eagle County:													
Holy Cross	1		3	6		6	1		1				211
Mount Egley	1		(1)	3		3	10		10				113
Red Cliff	2		144,840	155		155	57,353		57,353	17,000	1,380,000	32,873,000	4,215,446
Fremont County:													
Arkansas River	1		109	6		6	609		609	1,000	11,600	10,000	3,348
Cotopaxi	1		1,243	11		11	1,348		1,348	26,700	19,200	169,600	28,583
Currant Creek	1		91	1		1	105		105	500	1,300	8,000	1,319
Grape Creek	1		609	1		1	120		120	1,800	3,900	38,400	5,534
Garfield County: Rifle Creek	1		707	1		1	1,756		1,756		35,000	110,000	18,689
Gilpin County:													
Southern	7	8	6,226	305	37	342	3,224	6	3,230	4,800	117,100	57,000	35,076
Northern	2		19	6		6	104		104	200	900		424
Gunnison County:													
Gold Brick	2		1,288	118		118	162		162		1,400		4,414
Rock Creek	1		44				63		63	1,300	3,600	4,800	1,240
Taylor Park	2		145	2		2	2,260		2,260	100	107,000		13,575
Tomichi	2		4,220	25		25	12,718		12,718	38,600	666,000	880,200	197,382
Hinsdale County: Lake	1		11	3		3	442		442	4,000			1,110

See footnote at end of table.

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1946, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ores sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Jefferson County	1	3	3,100	86	6	92	849	1	850	83,000	----------	----------	$17,353
Lake County:													
California (Leadville)	26	1	323,080	10,729	20	10,749	332,021	3	332,024	195,000	8,881,200	11,992,000	3,107,155
St. Kevin	2	-------	31	31	-------	31	448	-------	448	----------	1,800	----------	1,643
La Plata County: California (La Plata)	4	-------	46	548	-------	548	360	-------	360	----------	----------	----------	19,471
Mineral County: Creede	7	-------	16,032	175	-------	175	355,110	-------	355,110	61,000	492,000	6,000	357,296
Montezuma County	1	-------	801	142	-------	142	344	-------	344	----------	----------	----------	5,248
Montrose County:													
La Sal	1	-------	4,414	16	-------	16	23,307	-------	23,307	292,000	----------	----------	66,696
San Miguel River	-------	1	----------	-------	2	2	----------	----------	----------	----------	----------	----------	70
Ouray County:													
Red Mountain	4	-------	183	2	-------	2	974	-------	974	1,200	49,000	20,200	8,856
Sneffels and Uncompahgre	5	-------	32,111	8,502	-------	8,502	193,323	-------	193,323	197,800	1,694,000	1,226,800	820,135
Park County:													
Alma Placers and Buckskin [2]	2	2	4,148	930	21	951	6,651	5	6,656	15,400	98,100	648,000	130,907
Consolidated Montgomery	1	-------	173	39	-------	39	3,079	-------	3,079	----------	----------	----------	3,853
Fairplay and Tarryall [2]	-------	4	----------	-------	19,043	19,043	----------	3,515	3,515	----------	----------	----------	669,345
Freshwater	1	1	28	1	5	6	36	1	37	700	3,600	----------	745
Mosquito	4	-------	306	49	-------	49	2,708	-------	2,708	900	20,300	35,000	10,532
Pitkin County: Roaring Fork	2	-------	8,420	1	-------	1	41,630	-------	41,630	----------	215,000	18,000	59,303
Rio Grande County: Summitville	1	-------	4,275	1,834	-------	1,834	2,338	-------	2,338	14,000	----------	----------	68,347
Routt County	1	-------	54	-------	-------	-------	63	-------	63	----------	----------	14,000	1,759
Saguache County: Kerber Creek	7	-------	5,003	57	-------	57	28,396	-------	28,396	86,000	478,000	480,000	149,533
San Juan County:													
Animas	8	-------	236,241	15,905	-------	15,905	339,088	-------	339,088	697,000	6,413,000	3,180,000	2,030,549
Eureka	6	-------	6,214	1,475	-------	1,475	18,469	-------	18,469	55,600	599,200	546,500	207,541
Ice Lake Basin	1	-------	386	16	-------	16	3,771	-------	3,771	4,400	71,800	30,500	15,867
San Miguel County:													
Iron Springs and Lower San Miguel [2]	3	-------	2,001	82	-------	82	2,839	-------	2,839	2,000	9,400	----------	6,513
Upper San Miguel	8	-------	206,805	24,648	-------	24,648	355,604	-------	355,604	1,319,000	4,752,600	3,925,000	2,360,569
Summit County:													
Breckenridge	9	2	7,333	302	102	404	19,020	22	19,042	21,000	111,000	2,219,500	315,806
Green Mountain	1	-------	223	4	-------	4	5,979	-------	5,979	900	5,200	51,000	11,906
Montezuma	6	-------	2,187	26	-------	26	14,230	-------	14,230	2,100	290,600	42,500	49,608
Ten Mile (Kokomo, Robinson)	7	-------	41,852	1,233	-------	1,233	88,995	-------	88,995	7,000	1,619,200	4,980,000	900,250
Teller County: Cripple Creek	25	-------	298,876	47,640	-------	47,640	7,536	-------	7,536	----------	----------	----------	1,673,489
Total Colorado	235	28	1,463,496	122,441	20,172	142,613	2,236,453	3,698	2,240,151	3,508,000	34,072,000	72,294,000	19,903,509

[1] Less than ½ ton.

[2] Bureau of Mines not at liberty to publish district production figures separately.

Gold Hill District.—James Pastore operated dumps of the American and Interocean claims of the United Empire Gold Mines & United Mines Co. from April through October and shipped 699 tons of gold ore containing 122 ounces of gold. James Pastore and Karl Egle operated the Big Horn mine from July through December and shipped 430 tons of gold ore containing 199 ounces of gold. Harrison S. Cobb operated the Emancipation group from February 1 through December 31 and the Ingram group during January only. A total of 392 tons of gold ore containing 121 ounces of gold was produced from the Emancipation group, and 328 tons of ore containing 98 ounces of gold were produced from the Ingram group. Lessees operated the Black Cloud mine in 1946 and produced 350 tons of ore; 90 tons, containing 1,075 ounces of gold, 1,991 ounces of silver, 276 pounds of copper, and 12,919 pounds of lead, were shipped direct to the Leadville smelter, and 260 tons were milled at the Wallstreet mill (leased from A. B. More). From the ore milled, 52 tons of concentrates containing 120 ounces of gold, 1,174 ounces of silver, 105 pounds of copper, and 4,456 pounds of lead were recovered. Other mines in the district from which shipments of ore were made in 1946 included the Home Sweet Home, Melvina, Parker No. 1, and Great Britain.

Grand Island District.—Clara Rugg operated the Enterprise mine from June 15 to October 15 and shipped 93 tons of gold ore. Other mines from which small shipments of gold ore were made in 1946 included the Blue Bird group, Eureka, and Shirley group.

Magnolia District.—Early in 1946 Henna Mines, Inc., purchased the Cash group of mines and began unwatering and retimbering the mine in April; 50 tons of ore containing 15 ounces of gold and 110 ounces of silver were shipped in August. A small shipment of gold ore was made from the Hereafter mine.

Sugar Loaf District.—Lessees operated the Poorman-Relief mine from January through March 15 and from April through August 10. Production was 407 tons of ore containing 288 ounces of gold and about an equal quantity of silver. Lessees operated the Alpine Horn mine and produced 242 tons of gold ore. The Hard Rock Mining Co. operated the Nancy group throughout 1946 and produced 161 tons of gold ore. Maud A. Coughlin operated the Herold mine from January through September and shipped 140 tons of ore containing 97 ounces of gold. Other mines from which less than 50 tons of ore were produced in 1946 included the Smoky Hill, Livingston Dike group, Wood Mountain & Franklin group, and Tambourine mine.

Ward District.—Harrison S. Cobb operated the Columbia mine for 2 weeks in February and shipped 36 tons of gold ore. Charles W. Strong, Jr., operated the Boston Lode from January 1 to 20 and shipped 16 tons of ore containing 30 ounces of gold, 15 ounces of silver, and 831 pounds of copper.

CHAFFEE COUNTY

Chalk Creek (Romley, St. Elmo) District.—A test shipment of ore was made in 1946 from the Stonewall claim.

Granite District.—The Good Hope Mining Co., Ltd., operated the Gold Basin placer from July 16 to October 15. The company used a gasoline-driven power shovel and caterpillar bulldozer to move the

stream gravel to a sluice. A small lot of gold ore was produced by lessees operating the Monogram mine.

Monarch District.—The Alaska and Little Annie claims of the Garfield mine group were operated throughout 1946. A total of 3,355 tons of zinc ore and 430 tons of copper ore was produced. The zinc ore contained 80 ounces of gold, 15,254 ounces of silver, 43,995 pounds of copper, 49,426 pounds of lead, and 1,139,202 pounds of zinc. The copper ore contained 5 ounces of gold, 7,518 ounces of silver, 51,429 pounds of copper, and 5,226 pounds of lead. Development completed in 1946 included 444 feet of drifts, 48 feet of crosscuts, 150 feet of winzes, and 70 feet of raises. The Utze Lode Mining Co. made test shipments of lead ore from the Madonna mine.

CLEAR CREEK COUNTY

Alice District.—The Lombard Mining & Milling Co. produced 120 tons of gold ore from development; the company began construction early in 1946 of a 100-ton flotation mill.

Argentine District.—O. Barlow Willmarth shipped 6 tons of lead ore from the National mine in January. The Lupton Mining Co. operated the Grizzly Gulch mine and 50-ton selective-flotation mill (purchased February 1) for 11 months. A total of 3,791 tons of gold-silver-copper-lead-zinc ore was treated.

Empire District.—The P. M. Leasers operated the Gold Fissure group intermittently for 9 months during 1946. Henry C. Nelson operated the Crown Prince group from April through December, producing 202 tons of gold ore and 1 ton of lead ore.

Griffith District.—The Utze Lode Mining Co. was the largest producer of zinc in Clear Creek County in 1946. The company operated the Mendota mine and 100-ton selective-flotation mill. Approximately 4,900 tons of zinc-lead ore were produced and treated. The Elida Mining Co. operated the Smuggler group throughout 1946 and produced about 3,000 tons of silver ore, which were treated in the Silver Leaf mill. The lead concentrates produced (109 tons) contained 8 ounces of gold, 42,886 ounces of silver, 1,365 pounds of copper, and 114,194 pounds of lead; and the zinc concentrates (217 tons) contained 5 ounces of gold, 4,397 ounces of silver, 901 pounds of copper, 6,757 pounds of lead, and 194,337 pounds of zinc. The Lupton Mining Co. operated the New Boston mine (purchased in February 1946) from January 1 through August 31 and produced 1,894 tons of gold-silver ore.

Idaho Springs District.—The Williams Mining Co. operated the Nixon claim and produced 14,767 tons of gold ore, which were treated in the company Gilpin-Eureka mill. LeRoy Giles & Co. operated the Dixie mine throughout 1946 and produced 2,933 tons of gold ore, which were treated in the leased Silver Spruce mill. A total of 1,854 ounces of gold and 680 ounces of silver was recovered as bullion; 66 tons of concentrates were recovered, which contained 257 ounces of gold, 3,709 ounces of silver, 424 pounds of copper, and 4,581 pounds of lead. Arthur Portenier operated the Silver Age claim, producing about 1,045 tons of gold-silver ore, and the Franklin claim, producing 285 tons of gold-silver ore, for a short time during the early part of 1946. The ores from these claims were treated at both the Silver

Spruce and Hoosac mills. The Franklin Mining Co. operated the Franklin claim after the Arthur Portenier permit to mine was terminated. Among other producing mines in the district were the Widow Woman, Dexter group, Diamond Mountain, Old Settler, and Kitty Clyde.

Montana District.—The Jo Reynolds mine was operated by the Elida Mining Co. The silver ore produced (about 1,200 tons) was treated in the Silver Leaf mill.

Trail Creek District.—The Harrison-Croesus Mining Co. operated the Ben Harrison mine throughout 1946 and produced 614 tons of ore.

CUSTER COUNTY

Hardscrabble District.—The Lady Franklin mine near Westcliffe, the largest producer of zinc in Custer County in 1946, was operated throughout the year by George L. Beardsley. A total of 2,720 tons of zinc-lead ore was mined and sent to the Leadville milling unit of the American Smelting & Refining Co. for concentration. Colgate & Hoge operated the Keystone mine from January to July and from September to December 15. A total of 1,122 tons of zinc-lead ore was produced and shipped to the Leadville milling unit for concentration. Henning, Kettle & Walker operated the Defender mine throughout 1946 and produced 907 tons of lead ore containing 3 ounces of gold, 5,695 ounces of silver, 238 pounds of copper, and 185,328 pounds of lead. A shipment of 13 tons of lead ore was made from the Revelle mine. The King of the Carbonates mine produced 12 tons of silver ore.

DOLORES COUNTY

Pioneer (Rico) District.—The Rico Argentine Mining Co., one of the large producers of lead and zinc in Colorado, operated its property near Rico continuously in 1946 and shipped lead and zinc concentrates to the Leadville and the Amarillo, Tex., smelters. Ore milled in the company 135-ton selective-flotation plant totaled 35,604 tons and averaged about 13 percent zinc and about 7 percent lead. Development during 1946 comprised 6,600 feet of drifts, 3,229 feet of tunnel, and 3,642 feet of diamond drilling. Markey Bros. operated the Yellow Jacket group under lease from the Rico Argentine Mining Co. and shipped 177 tons of zinc-lead ore to the Midvale, Utah, concentrator. Stamphel & Barnes shipped 101 tons of zinc-lead ore from the Nora Lilly mine to the Midvale, Utah, concentrator.

EAGLE COUNTY

Holy Cross District.—The Glengary Mines made a test shipment of gold ore from the French American claim.

Red Cliff (Battle Mountain) District.—The Red Cliff district continued to rank first among the Colorado districts in the total value of its production of the five metals. In 1946 the district produced 45 percent of the total output of recovered zinc in the State. The New Jersey Zinc Co. Empire zinc division operated its Eagle mine and 600-ton underground selective-flotation mill continuously during 1946; production remained almost constant the first half of 1946, decreased during July, September, and October, and increased again in Novem-

ber and December. The ore mined and milled yielded chiefly zinc concentrates, which were shipped to the company smelters at Depue, Ill., and Palmerton, Pa. A. H. Stoner made a test shipment of 3 tons of gold ore from the Stoner mine.

EL PASO COUNTY

Golden Cycle Mill.—The Golden Cycle mill at Colorado Springs operated throughout 1946 on company and custom ores; 306,790 tons of ores of all classes were treated in 1946 compared with 227,063 tons in 1945. Of the total ores treated, 299,438 tons were company and custom gold-silver sulfotelluride ores from the Cripple Creek district (Teller County), 4,911 tons were gold ore from Boulder, Chaffee, Clear Creek, Gilpin, and La Plata Counties, and 2,441 tons were zinc-lead middlings from Lake County. About 70 percent of the ores treated from the Cripple Creek district came from the mining of dumps. The Golden Cycle Corp. ceased purchasing complex ores in December 1945; in 1946, except during February when zinc-lead middlings were accepted from the Ore & Chemical Co. because of terms of a previous contract, the company purchased only gold and gold-silver ores. (See Teller County section for other details.)

FREMONT COUNTY

Arkansas River District.—Mock & McKinney shipped 109 tons of slag from the Florence smelter site to the Leadville smelter.

Cotopaxi District.—The Monarch Galena Co. operated its Cotopaxi mine from January 1 to July 14 and produced 1,148 tons of zinc ore containing 17 ounces of gold, 1,811 ounces of silver, 27,345 pounds of copper, 25,294 pounds of lead, and 267,600 pounds of zinc; and 95 tons of copper ore containing 2 ounces of gold, 216 ounces of silver, and 10,142 pounds of copper. Fire destroyed the mine buildings on July 14. The lease on this property was taken over in October by Jean H. Eicheim.

Current Creek District.—The Warwick Mining Co. operated the Isabel mine from April to October. Production was 91 tons of zinc ore containing 2 ounces of gold, 168 ounces of silver, 866 pounds of copper, 1,723 pounds of lead, and 12,824 pounds of zinc.

Grape Creek District.—Eichheim & Hart shipped 609 tons of zinc ore from the Horseshoe mine to the Leadville milling unit of the American Smelting & Refining Co. during 1946.

GARFIELD COUNTY

Rifle Creek District.—Burney, Nall & Fischer operated the Grandview group from March through December and produced 707 tons of zinc-lead ore containing 2 ounces of gold, 1,944 ounces of silver, 75 pounds of copper, 39,300 pounds of lead, and 128,675 pounds of zinc. The ore was shipped to the Tooele, Utah, smelter.

GILPIN COUNTY

Southern (Blackhawk, Central City, Nevadaville, Russell Gulch) Districts. The Success Gold Mining & Milling Corp. operated the Pittsburg-Notaway group intermittently during 1946, shipped dump

ore from the Ivanhoe mine, and made test shipments from the Meeker-Success group. Ores from the Pittsburg-Notaway and Meeker-Success groups were treated at the Pittsburg 30-ton flotation mill; ore from the Ivanhoe dump was treated at the J. & R. 100-ton flotation mill. The Lu Ev Mining Co. operated the New Brunswick and Silver Dollar claims throughout 1946 and produced about 1,710 tons of gold ore, 10 tons of which were shipped direct to the Golden Cycle mill and about 1,700 tons treated in the company amalgamation-concentration mill. H. L. Griffith operated the Boodle mine. The ore produced was milled and made about 70 tons of zinc-lead concentrates, which were shipped to the Tooele, Utah, smelter. Among other mines active in the district in 1946 were the Saratoga, Gumtree, and Duchess. Several small-scale hand placer operations on the north fork of Clear Creek and in Gregory Gulch were active during 1946.

Northern District.—Small shipments of gold ore were made from the Evergreen mine and from cleanup at the Perigo mill.

GUNNISON COUNTY

Gold Brick District.—The Carter Mines, Inc., acquired the Carter mine in April 1946; remodeling of the mill and preparations for mining were begun on April 8. The first shipments of bullion were made in October; concentrates made in 1946 were not shipped until January 1947. The Murray Davis Lease operated the Gold Links mine.

Rock Creek District.—In July A. J. Betz shipped 44 tons of zinc-lead ore, mined in 1945, from the Catalpa mine to the Leadville milling unit of the American Smelting & Refining Co.

Taylor Park District.—John Lambertson operated the Star mine throughout 1946 and produced 101 tons of lead ore containing 1 ounce of gold, 1,578 ounces of silver, 203 pounds of copper, and 75,262 pounds of lead. J. A. McLain shipped 44 tons of lead ore from the Bull Domingo mine to the Leadville smelter in August.

Tomichi District.—The Callahan Zinc-Lead Co., Inc., continued to operate its Akron unit at White Pine during 1946. The unit comprises a large number of claims, of which only the Lost Contact, Erie, and Sunset lodes were productive during 1946. The ore mined was shipped to the Midvale, Utah, concentrator and the Leadville milling unit of the American Smelting & Refining Co. for treatment. A total of 4,220 tons of ore containing approximately 50 ounces of gold, 20,044 ounces of silver, 62,507 pounds of copper, 887,950 pounds of lead, and 1,389,551 pounds of zinc was treated. Development during 1946 included 19 feet of shaft, 500 feet of drifts, and 800 feet of diamond drilling.

HINSDALE COUNTY

Lake District.—James M. Wells operated the Gold Quartz mine from May 15 to December 5 and shipped 11 tons of ore containing 3 ounces of gold, 442 ounces of silver, and 4,192 pounds of copper.

JEFFERSON COUNTY

The Malachite mine, 3½ miles northwest of Morrison, was reopened by R. M. Moore in July. The mine has a complex copper-zinc ore which was first milled at the Silver Spruce mill near Idaho Springs

and later at the company mill at Dumont. About 3,100 tons of ore were treated, and 167 tons of copper concentrates were made, which contained 86 ounces of gold, 849 ounces of silver, and 85,030 pounds of copper; shipments of concentrates were begun in September. A small quantity of gold was recovered as a byproduct at the J. B. Bertrand concrete-aggregate gravel plant and from two small hand placer operations on Clear Creek near Golden.

LAKE COUNTY

California (Leadville) District.—The American Smelting & Refining Co. operated its Arkansas Valley lead bullion-leady copper matte smelter from January 1 to February 1, when the smelter was closed in order to build up a stock pile of ores (from February 25 through June 17 the workers were on strike and ore shipments, except those in transit, were refused), and from June 20 throughout the remainder of 1946. A total of 67,805 tons of material was received for treatment, of which 62,922 tons were considered of domestic origin and 4,883 tons of foreign origin. About 50,182 tons of ores, concentrates, and slag came from mines in almost every active district in Colorado; the remainder was largely residues from smelters or reduction plants in Illinois, New Jersey, Oklahoma, Pennsylvania, and Virginia. Foreign ores were chiefly from the New Calumet Mines, Ltd., Quebec, Canada, part of which was purchased through the Office of Metals Reserve and part direct. The American Smelting & Refining Co. operated its Leadville milling unit throughout 1946, and treated company ores from its Kokomo unit and custom ores from mines in Chaffee, Clear Creek, Custer, Fremont, Gunnison, Lake, Mineral, Ouray, Park, Pitkin, Saguache, San Juan, and Summit Counties.

The Resurrection Mining Co. operated its Resurrection mine throughout 1946, and was the largest producer of lead and zinc in the county. Production was chiefly from the Dolly B, Annie C, Lizzie C, Polaris No. 1, and Famous claims. The property is equipped with a 600-ton selective-flotation mill which has two 300-ton units. In addition to treating company zinc-lead ore, custom ores from mines in Clear Creek, Lake, Park, Saguache, and Summit Counties were handled.

The Ore & Chemical Co. operated its 1,000-ton heavy media separation plant from January to August and treated ores from the Small Hopes, Robert E. Emmett, Colorado No. 2, and Colonel Sellers dumps. The middling product made was shipped to the Leadville milling unit, Leadville smelter, Golden Cycle mill, and Combined Metals Reduction Co. plant at Bauer, Utah.

John Hamm Mining & Milling, Ltd., operated its 600-ton gravity-concentration mill the entire year on ores from the Wolftone, A. Y. & Minnie, and Mahala dumps. The middling product was shipped to the Leadville milling unit, Resurrection mill, and Combined Metals Reduction Co. plant at Bauer, Utah.

The American Smelting & Refining Co. shipped a considerable tonnage of slag from the American smelter dump to the Leadville smelter. Paul R. Clark operated the Fortune mine during the first quarter and produced 3,783 tons of zinc-lead ore. Robert L. Jones, operating the Sunday claim under lease from the Garibaldi Lease,

shipped 2,971 tons of zinc-lead ore beginning in March. The Ibex Mining Co. and W. E. Wilson & Co. operated the Ibex mine throughout 1946. The Reynolds-Young Lease operated the Little Jonny claim from January 1 to May 31 and produced 1,353 tons of zinc-lead ore. McCaughlan & Co. operated the Dolly B mine throughout 1946, and produced 1,307 tons of zinc-lead ore and 251 tons of lead smelting ore. John Bogunovich operated the Commerce mine from June through November and produced 976 tons of gold-silver ore. R. C. Nelson operated the New Monarch mine throughout 1946, and produced 998 tons of zinc ore and 358 tons of lead smelting ore. Harry Sundstrom & Co. operated the Valley Lease throughout 1946. Clyde F. Jones operated the Colorado No. 2 claim during August, September, and October and produced 448 tons of lead ore. Other producers operating in the district in 1946, were Bogunovich & Webster (Adelaide mine), Joseph Kerzon (St. Louis mine), Rock Hill Mines Co. (Rock and Dome mines), Eddie Patterson (New Monarch dump), Baillie-Turnipseed Lease (Hummer Lode), M. & K. Mining Co. (Yukon mine), and John Joyce (Breece mine). All of the above producers shipped to the Leadville smelter, Leadville milling unit, or Resurrection mill. A total of 20 ounces of gold and 3 ounces of silver was recovered by a small hand-placer operation on the Key placer.

St. Kevin District.—Markus Thuren operated the Lakewood mine during September and October; the gold-silver ore produced was sent to the Leadville smelter. A total of 11 tons of lead ore was shipped from the St. Kevin mine to the Leadville smelter in October.

LA PLATA COUNTY

California (or La Plata) (Hesperus, La Plata) District.—Producers operating in the district during 1946 and shipping high-grade gold ore or bullion included Bert Thompson, Glen W. & Dean Stewart, A. B. Crosby, and Frank C. Rand, Jr.

MINERAL COUNTY

Creede District.—The Emperius Mining Co. operated its 100-ton flotation mill throughout 1946, on ore from the Commodore, Amethyst, New York, and Del Monte-Aspen groups and Equinox mine. The mill was operated on a three-shift basis 7 days a week and treated 15,433 tons of silver ore, of which 15,153 tons were company ore, averaging 0.0092 ounce of gold and 25.69 ounces of silver per ton and 2.01 percent lead. The company also produced 311 tons of silver ore, containing 2 ounces of gold, 15,495 ounces of silver, and 24,359 pounds of lead, which were sent direct to the Leadville smelter. P. B. Davis shipped 280 tons of silver ore from the Equity dump to the Emperius mill. The New Ridge Mining Co. operated its property throughout 1946, and shipped lead and zinc-lead ores to the Leadville milling unit, Leadville smelter, and Midvale, Utah, concentrator.

MONTEZUMA COUNTY

The Ute Mining Co. operated the Red Arrow group and its 25-ton amalgamation-flotation mill 9 miles northeast of Mancos from May 1 to December 1. A total of 801 tons of gold ore was treated.

MONTROSE COUNTY

La Sal District.—The New Cashin Mines, Inc., operated the Cashin group of claims continuously throughout 1946 and shipped 4,414 tons of copper ore containing 16 ounces of gold, 23,307 ounces of silver, and 297,773 pounds of copper to the Garfield smelter.

OURAY COUNTY

Red Mountain District.—Four properties were productive in the district during 1946. They included, in order of output, the Beaver and Belfast claims, Lost Day mine, Dauntless group, and Red Mountain mine.

Sneffels District.—The largest producer in Ouray County in 1946 was the Camp Bird mine and its 100- to 125-ton amalgamation-flotation mill operated by King Lease, Inc. Development in 1946 included 760 feet of raises, 1,232 feet of drifts, and 1,864 feet of diamond drilling.

Uncompahgre District.—The General Ore Reduction Co. operated its 60-ton mill until July, when it was sold to the American Zinc Lead & Smelting Co. The American Zinc Lead & Smelting Co. immediately began remodeling and enlarging the mill (renamed American No. 1) to approximately 350-ton capacity by adding new equipment and transferring equipment from its Hunter mill in Aurora, Mo. During remodeling, the company continued to operate the original 60-ton unit on company and custom ores. During 1946 the American Zinc Lead & Smelting Co. also acquired the Sonza lease on the Bachelor mine and a lease on the Portland group (in the Uncompahgre district) and the San Antonio group (in the Red Mountain district—part of the San Antonio group lies in San Juan County). Operation of these properties was begun by the company late in 1946. The Bachelor mine was operated under the Sonza lease by J. R. Sonza until the American Zinc Lead & Smelting Co. took possession. The Southwest Metals Co. operated the Michael Breen and Monarch claims throughout 1946 and produced 2,885 tons of zinc-lead ore.

PARK COUNTY

Alma Placers District.—S. F. Bradford operated a nonfloating washing plant on the Alma placer in 1946.

Buckskin District.—The Buckskin Joe Mines, Ltd., operated its Phillips group of mines throughout 1946 and produced 4,011 tons of zinc ore and 41 tons of gold ore. The company mill burned December 12, 1945, and in 1946 the zinc ore was sent to the Resurrection mill at Leadville for beneficiation and gold ore direct to the Leadville smelter. The Niagara Mines, Ltd., operated the Sweet Home and Bluebird claims (part of the Sweet Home group) from February 11 through December 31. A small quantity of gold and silver was recovered from the Buckskin placer.

Consolidated Montgomery District.—John H. Snyder operated the Cresskill and Star claims on Mount Bross from July 1 through October 15; 173 tons of ore containing 39 ounces of gold and 3,079 ounces of silver were shipped to the Leadville smelter.

Fairplay District.—The South Platte Dredging Co. operated its electrically powered connected-bucket dredge (with 103 12-cubic foot buckets) on the Lee Andrews and Cincinnati placers throughout

1946; about 4,844,000 cubic yards of gravel were washed. The Timberline Dredging Co. resumed operation of its dragline dredging operation on the Snowstorm Placers May 17 and operated until November 4; the plant had been idle since 1942. About 440,000 cubic yards of gravel were washed in 1946. A few ounces of gold were recovered in the district by small-scale hand-placer operations.

Freshwater District.—Welsh Industries, Inc., made test shipments of ores from its properties. N. Gow recovered a small quantity of gold by a small-scale hand-placer operation.

Mosquito District.—M. J. Krokicki operated the Orphan Boy mine from June through December and produced 158 tons of zinc-lead ore. R. M. Taylor operated the Hock Hocking group and the Evening Star mine from June 1 to December 15, producing 129 tons of silver ore from the Hock Hocking group and 15 tons of silver ore from the Evening Star mine.

Tarryall District.—Cooley Bros. resumed dredging operations on Tarryall Creek May 19 and worked until December 3, using a Bodinson electric washing plant, 3½-cubic yard dragline, and two bulldozers.

PITKIN COUNTY

Roaring Fork (Aspen) District.—The Midnight Mining Co. operated its Midnight mine and 50-ton selective-flotation mill throughout 1946. A total of 4,990 tons of ore, containing 54,391 ounces of silver, 257,484 pounds of lead, and 214,570 pounds of zinc, was produced, from which 175 tons of lead concentrates containing 38,689 ounces of silver and 130,555 pounds of lead were recovered. Herron Bros. operated its 150-ton gravity-concentration mill on dump ores intermittently during 1946.

RIO GRANDE COUNTY

Summitville District.—The Gold Links Mine operated its mine and 65-ton amalgamation and flotation-concentration mill from January 1 to June 20, and the Summitville Mining Co. operated the property from June 21 throughout the remainder of 1946. A total of about 4,500 tons of ore averaging 0.509 ounce of gold and 0.73 ounce of silver per ton and 0.246 percent copper was treated. Development in 1946 included 100 feet of shaft and 100 feet of drifts.

ROUTT COUNTY

Milbank Franz worked the Greenville mine in the Hahns Peak area during 1946 and shipped 54 tons of zinc ore to the International Smelting & Refining Co.

SAGUACHE COUNTY

Kerber Creek (Bonanza) District.—The Superior Mines Division of the Conejos Corp. operated the Superior-Erie group of mines throughout 1946 and was the largest producer of the five metals in the county. The Pratt-Bonanza Mining & Milling Co. operated its St. Louis mine from January 1 to July 17 and produced 290 tons of ore. Wm. J. Costello operated the Rawley group throughout 1946 and produced 160 tons of lead ore and 221 tons of copper ore. Nicholas Keserich operated the Warwick group intermittently from January 1 to October 15. Other properties producing in the district during

1946 included the Vallejo mine operated by Tom Raymond & Sons, Shawmut mine operated by Geo. R. Smith, and the Cora group operated by Nevada Mines Co.

SAN JUAN COUNTY

Animas District.—The Shenandoah-Dives Mining Co. was the chief producer of metals in San Juan County in 1946. The company worked the Shenandoah-Dives consolidated group of claims on King Solomon Mountain and the Silver Lake group of properties, owned by the American Smelting & Refining Co. In 1946 a total of 175,121 tons of company ore and 3,844 tons of custom ore was milled in the 700-ton Shenandoah-Dives selective-flotation mill. A total of 5,171 tons of concentrates was made, including 2,904 tons of flotation mill concentrates, 1,466 tons of flotation zinc concentrates, and 801 tons of iron-gold-silver-lead table concentrates containing in aggregate 11,941 ounces of gold, 131,095 ounces of silver, 406,885 pounds of copper, 2,234,240 pounds of lead, and 1,666,754 pounds of zinc. Development completed during 1946 included 2,681 feet of drifts, 182 feet of crosscuts, 229 feet of raises, and 741 feet of diamond drilling.

The Denver Equipment Co., as agent, operated the Pride of the West group and Green Mountain mines and the Pride 100-ton selective-flotation mill at Howardsville during 1946 for the owners of the property—Pride of the West, Inc.; 30,972 tons of ore were treated. Development during 1946 included 104 feet of shaft, 910 feet of drifts, and 550 feet of diamond drilling.

Highland Mary Mines, Inc., operated its Highland Mary mine and 100-ton selective-flotation mill in Cunningham Gulch from April 16 to December 31. A total of 19,129 tons of ore, averaging 0.11 ounce of gold and 3.36 ounces of silver per ton and 0.11 percent copper, 2.34 percent lead, and 0.20 percent zinc, was treated. The U. S. Coal Corp. operated the Lark mine throughout 1946. The Osceola mine was operated on lease from March 1 to December 31; 1,008 tons of ore containing 19 ounces of gold, 1,590 ounces of silver, 12,384 pounds of copper, 84,539 pounds of lead, and 124,724 pounds of zinc were produced. Other producing mines in the district included the Coming Wonder and Belcher.

Eureka District.—The Lead Carbonate Mines operated the Lead Carbonate mine from July 1 to December 31. The Foursome Mining Co. operated the Columbus mine throughout 1946 and produced 2,541 tons of zinc-lead ore. A. R. Walker operated the Mountain Queen mine and produced 475 tons of ore containing 14 ounces of gold, 3,815 ounces of silver, 5,928 pounds of copper, 45,612 pounds of lead, and 50,739 pounds of zinc. Other mines in the district from which small quantities of ore were produced included the Toltec No. 3, Tom Moore, and Burrows.

Ice Lake Basin District.—The Bandora mine was operated by the Esmeralda Lease and produced 386 tons of ore containing 39 ounces of gold, 4,899 ounces of silver, 6,655 pounds of copper, 91,298 pounds of lead, and 54,326 pounds of zinc.

SAN MIGUEL COUNTY

Iron Springs District.—The Silver Bell Mines Co. reopened the Silver Bell group and began construction early in 1946 of a 100-ton

flotation-concentration mill at Ophir. The mill was not completed during 1946; however a considerable tonnage of ore from development was treated in test runs from September through December. A small quantity of bullion was shipped from the New Dominion mine to the Denver Mint.

Upper San Miguel (Telluride) District.—Telluride Mines, Inc., operated throughout 1946 on the Smuggler-Union and Montana groups. The ore produced was treated in the company 550-ton amalgamation and gravity- and flotation-concentration mill; no custom ore was treated. Development in the mine in 1946 included 354 feet of raises, 2,773 feet of drifts, and 995 feet of tunnel; the lower level adit, on which work was begun late in 1945, had been driven 1,000 feet by the end of 1946.

The production of the Idarado Mining Co. is credited to San Miguel County, although the property is developed and worked through the 12,000-foot Treasury tunnel, with its portal in Ouray County, because the ore comes from claims in San Miguel County. During 1946 the Idarado Mining Co. continued to develop its Black Bear property through the Treasury tunnel; ore produced was treated in its 300-ton selective-flotation mill. Development in 1946 included 2,351 feet of raises, 14,555 feet of drifts, and 2,399 feet of diamond drilling.

Alta Mines, Inc., operated the Alta-St. Louis mine and its 100-ton flotation mill throughout 1946. Other properties producing in the district included the Breckenridge mine, Juan millsite, Allegheny mine, and Telluride claim. Production from these mines was chiefly gold recovered by amalgamation of high-grade ore.

SUMMIT COUNTY

Breckenridge District.—The Garvie London Gold Mining Co. operated its Country Boy mine throughout 1946 and produced a considerable quantity of zinc ore, which was shipped chiefly to the Resurrection mill for concentration. Development completed during 1946 included 620 feet of drifts and 760 feet of raises. The Sally Barber mine was operated by F. P. Lilly and T. C. Moran under lease and produced about 3,143 tons of zinc ore, which were shipped to the Tooele, Utah, concentrator. Other mines which were operated in the district during 1946 included the Jumbo, Minnie B. Lode, Little Fool, Fredonia, and Virginia. A total of 102 ounces of gold and 22 ounces of silver was produced from placer operations on the Highbar placer and Williams placer.

Green Mountain District.—Walter McDaniel operated the Big Four mine intermittently during 1946 and produced about 169 tons of zinc ore and 54 tons of silver ore.

Montezuma District.—The Florado Mining Co. operated its Pinnacle mine and 100-ton flotation mill intermittently during 1946. The Summit Mining & Milling Co. operated the Silver King mine and its 60-ton flotation mill for a short time early in the spring of 1946. Max L. Bunker operated the Ida Belle group and produced 185 tons of zinc-lead ore, which were shipped to the Resurrection mill and the Leadville milling unit for concentration. Jeffrey & Ulibarri operated the Erickson mine from January 1 to September 10. Small quantities of ore were produced from the Morgan group operated by Rogers Mines,

Inc., and the Bullion group operated under lease by George W. Goodman.

Ten Mile (Kokomo, Robinson) District.—The American Smelting & Refining Co. operated its Kokomo unit (Lucky Strike group, Victory, and Wilson mines) throughout 1946. The greater part of the production was from the Victory mine; development at this property included 300 feet of shaft, 150 feet of drifts, and 10,565 feet of diamond drilling. All the ore produced during 1946, except minor tonnages of high-grade ore sent direct to the Leadville smelter, was sent to the company Leadville milling unit for concentration. The Wilfley Leasing Co. operated the Wilfley mine throughout 1946 and produced 5,795 tons of ore containing 422 ounces of gold, 25,262 ounces of silver, 213,409 pounds of lead, and 1,202,189 pounds of zinc, all of which was sent to the Resurrection mill for concentration. The Kokomo-Kimberly Mines, Inc., operated the Kimberly mine and produced about 2,650 tons of ore. The Snowbank mine was operated by the Clark McKey Development Co. and produced 1,381 tons of zinc-lead ore. Some silver ore was produced from the Queen of the West mine.

TELLER COUNTY

Cripple Creek District.—The Cripple Creek district yielded 33 percent of the total gold production of the State in 1946. From 1891, when gold was discovered in the area, through 1946 the district has yielded 18,572,899 fine ounces of gold valued at $403,625,947, or 48 percent of the State total output of gold from 1858 to 1946, inclusive. The total production of ore from Cripple Creek mines and dumps in 1946 was 298,876 tons—all treated in the Golden Cycle mill (see El Paso County).

Operations of the Golden Cycle Corp., which owns and operates the Golden Cycle mill at Colorado Springs and several mines in the Cripple Creek district, are described in the following extract from its annual report to stockholders for the year ended December 31, 1946 (dated April 14, 1947):

Golden Cycle Mill.—The total tonnage of ore handled at the Golden Cycle mill in West Colorado Springs, for 1946 was the largest since 1942. A total of 306,790 dry tons with a total gross value of $1,972,911 and an average per ton value of $6.43, were treated during the year. This compares with 1939 (our last normal year) when 545,323 tons with a total gross value of $5,592,772 and an average per ton value of $10.26, were treated. Of the total tonnage handled in 1946, 210,282 tons or 70 percent were low-grade dump ore and the balance of 30 percent was mine ore.

During the past year a considerable amount of rehabilitation of the equipment in various mill departments was done. It was necessary to do this since, due to the lack of labor, materials, etc., it had been impossible during the war years to do all of the essential maintenance work which was absolutely necessary.

Metal Mining Operations.—Total ore production of the Golden Cycle-Cripple Creek mining operations for 1946 was 108,805 tons with a total gross value of $682,617 and an average per ton value of $6.27. Of this tonnage, however, 84,555 tons with a total gross value of $215,342 and an average per ton value of $2.55 were shipped from the Granite and Dillon dump operations on the Ajax mine. In addition, operating as a lessee, the Golden Cycle Corp. shipped from the Theresa dump, owned by the United Gold Mines Co., 93,353 tons of ore with a total gross value of $297,153 and an average per ton value of $3.18.

Ajax Operation.—In 1946 company and lessee operations produced and shipped a total of 20,303 tons of ore with a total gross value of $432,297 and an average per ton value of $21.29.

Development work during the year amounted to a total of 3,413 feet of drifts, crosscuts, and raises.

Anchoria Leland.—During 1946 all work on this property was done by lessees with a total of 1,298 feet of drifts, crosscuts and raises driven. A total of 3,862 tons of ore with a total gross value of $34,541 and an average per ton value of $8.94, were produced and shipped during the year.

Cameron and Index.—During 1946 lessees shipped 3 cars of dump material from these two properties.

Carlton Drainage Tunnel.—During 1946 water continued to flow from the Carlton drainage tunnel at the rate of approximately 4,000 gallons per minute. No trouble of any kind was experienced with tunnel operations.

The annual report of the United Gold Mines Co., an operating and holding company for property scattered throughout the Cripple Creek district, for the year ended December 31, 1946 (dated February 1, 1947), gives the following details on operations at individual mines:

Net loss for 1946 was $62,007 vs. net loss in 1945 of $408, a loss increase of $61,599. Current assets at the close of 1946 were $100,235 vs. current assets of $169,349, in 1945 a decrease of $69,114. Taxes of all kinds paid in 1946 were $11,427, compared to $11,253 in 1945, an increase of $174.

During 1946 a total of 11,274 feet of work was done consisting of 2,560 feet of drifts and crosscuts on the Vindicator and Portland properties by the company, and 8,714 feet of development work by the lessees.

Total production during 1946 was 149,366 tons of ore with a gross value of $700,629, an average per ton value of $4.69.

Production of company ore by United Gold Mines Co. in 1946

Mine	Net tons	Gross value [1]	Company or cash receipts	Average gross value per ton [1]
Vindicator	3,055	$12,295	$3,033	$4.02
Portland	5,072	37,751	19,574	7.44
No. 2 plant	16,818	58,343	11,032	3.47
Cycle dump	93,353	297,153	23,561	3.18
Total	118,298	405,542	57,200	3.43

[1] Gross value calculated at settlement value.

Production of lessee ore of United Gold Mines Co. in 1946

Group	Net tons	Gross value [1]	Royalties received	Lessees' receipts	Average gross value per ton [1]
Vindicator	18,202	$131,515	$28,008	$37,891	$7.23
Rose Nichol	255	1,587	119	635	6.23
Portland	5,832	106,550	38,986	38,296	18.27
Bull Hill	6,780	55,435	4,618	24,768	8.17
Total	31,069	295,087	71,731	101,590	9.50

[1] Settlement value.

Production of properties of United Gold Mines Co. before and after organization of the company (May 15, 1902) to Dec. 31, 1946

	New tons	Gross value [1]
Ore mined before consolidation	26,310	$456,806
Production under operation of United Gold Mines Co	2,768,569	27,016,542
Total to Dec. 31, 1946	2,794,879	27,473,348

[1] Settlement value.

The annual report of the Cresson Consolidated Gold Mining & Milling Co. for the calendar year 1946 (dated February 1, 1947), says—

After the resumption of operations on April 1, 1946, some progress was made toward normal operations. However, on the afternoon of July 22, the Cresson mine suffered one of the worst catastrophes in its long history. The surface commenced caving not far from the Cresson shaft, and within a space of minutes the blacksmith shop, the trestle work, and some of the other mine buildings disappeared in the large surface hole created by the cave-in. Before caving had stopped the steel shop, the warehouse and upper end of the tramway were pulled into the cavity and from this wreckage only a small amount of equipment was saved.

Immediately after the cave-in work was started to fill in the tremendous cavity with dump and waste material. It was necessary to remove remaining buildings which were in jeopardy of being lost down the hole.

Our engineers estimate that at least 120,000 yards of waste were poured into the hole.

Operations were again resumed on the Cresson mine October 21, and are now continuing. During the year development consisted of 984 feet of drifts, crosscuts and raises.

Production of Cresson Consolidated Gold Mining & Milling Co., 1903 to Dec. 31, 1946

Period	Dry short tons	Gross value [1]	Freight and treatment	Net value
1903 to Dec. 31, 1945	3,218,358	$46,471,267	$15,352,230	$31,119,037
1946:				
Company ore	2,146	21,466	9,295	12,172
Lessee ore	14,828	178,324	66,029	112,295
1903 to Dec. 31, 1946	3,235,332	46,671,057	15,427,554	31,243,504

Period	Royalties received by company	Amount paid lessees	Average gross value per ton	Average net value per ton	Dividends
1903 to Dec. 31, 1945			$14.44	$9.67	$13,564,673
1946:					
Company ore			10.00	5.67	
Lessee ore	$59,295	$53,000	12.03	7.57	
1903 to Dec. 31, 1946			14.43	9.66	[2] 13,564,673

[1] Settlement value.
[2] Represents 29.06 percent of gross value and 43.42 percent of net value.

Shipments from the Stratton Estate properties in 1946 totaled 10,376 tons of ore containing 2,525 ounces of gold. Ore was produced by lessees operating on the Orpha May, Favorite, Geneva, Logan, and Proper claims. Mines, Inc., carried on an extensive sampling program of several properties of the Stratton Estate on Globe Hill; the samples were sent to the Golden Cycle mill for testing. Among other mines and dumps operating in the Cripple Creek district in 1946, in order of output, were the Acacia, Free Coinage, Le Clair, Strong, Joe Dandy, Empire Lee, Gold King, and Elkton.

Eastern States
Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By A. J. MARTIN

GENERAL SUMMARY

ECONOMIC conditions in 1946 were generally favorable for copper, lead, and zinc mining but afforded no incentive for resumption of gold mining in the Eastern States. Since 1943 nearly all the output of gold and silver has been incidental to the production of other metals. The labor shortage was ameliorated gradually during 1946, and a number of the base metal mines stepped up production rates. The output of lead increased 8 percent and copper 3 percent over 1945. During several months of 1946 zinc production was unusually low, as labor strikes interrupted operations at certain mines. Because of the strikes and of the closing in January of a low-grade open-pit mine that had been an important producer since October 1943, the output of zinc again decreased 11 percent. The removal of price ceilings from base metals, effective November 11, 1946, was a propitious event for the copper-, lead-, and zinc-mining industry of the Eastern States. Some of the mines operated throughout the nearly 5 years during which the Premium Price Plan served as an adjunct to price control without receiving a premium on any part of their output. Premium and overceiling payments in 1946, calculated on the entire Eastern States output, averaged about 3 cents a pound of recoverable copper, 0.13 cent a pound of lead, and 0.38 cent a pound of zinc. As the last price ceilings were 14.375 cents for copper, 8.25 cents for lead, and 9.25 cents for zinc, the advance in the free-market price of copper to 19.5 cents, lead to 12.5 cents, and zinc to 10.5 cents from November 11 through December raised materially the average prices received by the mines.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported, except that of zinc in New Jersey, has been calculated at the prices in the following table. The value of the New Jersey output is the total value of the

Prices of gold, silver, copper, lead, and zinc, 1942–46

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per ounce fine	*Per ounce fine*	*Per pound*	*Per pound*	*Per pound*
1942	$35.00	$0.711+	$0.121	$0.067	$0.093
1943	35.00	.711+	.130	.075	.108
1944	35.00	.711+	.135	.080	.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+($20.671835) per fine ounce.

[2] Treasury buying price for newly mined silver, 1942 to June 30, 1946: $0.71111111; July 1, 1946 to Dec. 31, 1946: $0.905.

[3] Yearly average weighted price of all grades of primary metal sold by producers; price includes bonus payments by Office of Metals Reserve for overquota production.

zinc recoverable as metal and oxide after freight, haulage, smelting, and manufacturing charges are added.

Annual figures for the 5 years ended with 1946 are given in the table that follows. The figures for tonnage of ore sold or treated do not include magnetite ore containing pyrite and chalcopyrite, from which copper, gold, and silver were recovered as byproducts.

Mine production of gold, silver, copper, lead, and zinc in the Eastern States, 1942–46, in terms of recovered metals

Year	Mines producing		Ore sold or treated (short tons) [1]	Gold (lode and placer) [2]		Silver (lode and placer) [3]	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1942	36	17	4,130,226	14,699	$514,465	105,307	$74,885
1943	29	3	4,211,961	2,878	100,730	128,129	91,114
1944	26	2	4,202,461	2,595	90,825	124,006	88,182
1945	24		3,718,073	1,857	64,995	81,983	58,299
1946	22	5	3,236,000	1,432	50,120	76,964	62,187

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Short tons	Value	Short tons	Value	
1942	28,404,000	$3,436,884	4,475	$599,650	199,809	$36,190,180	$40,816,064
1943	28,490,000	3,703,700	4,843	726,450	199,233	39,225,222	43,847,216
1944	30,098,000	4,063,230	6,266	1,002,560	176,327	35,977,536	41,222,333
1945	24,910,000	3,362,850	5,159	887,348	156,269	31,520,742	35,894,234
1946	25,700,000	4,163,400	5,579	1,216,222	138,488	29,765,642	35,257,571

[1] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.
[2] Includes placer gold as follows: 1942, 69 ounces; 1943, 12 ounces; 1944, 5 ounces; 1945, none; 1946, 22 ounces.
[3] Includes placer silver as follows: 1942, 3 ounces; 1943–46, none.

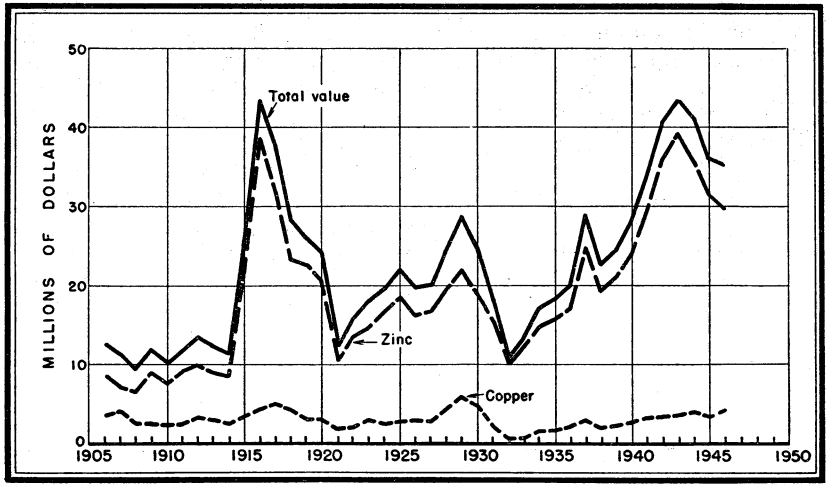

FIGURE 1.—Value of zinc and copper and total value of gold, silver, copper, lead, and zinc in the Eastern States, 1906–46. The combined value of gold, silver, and lead has not exceeded $1,485,660 annually in any year of the period.

Mine production of gold, silver, copper, lead, and zinc in the Eastern States, 1946, by months

[In terms of recovered metals]

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (short tons)	Lead (short tons)	Zinc (short tons)
January	159	7,696	1,097	458	13,524
February	60	7,256	790	575	11,366
March	161	8,138	1,083	677	12,633
April	106	7,981	1,084	693	12,593
May	125	10,660	1,209	268	12,860
June	130	8,477	1,132	526	9,266
July	100	5,005	1,046	443	7,102
August	122	4,506	1,092	492	9,129
September	127	4,750	1,108	409	12,135
October	124	4,398	1,113	406	13,377
November	114	3,934	1,086	314	12,377
December	104	4,163	1,010	318	12,126
Total 1946	1,432	76,964	12,850	5,579	138,488

Gold.—There was little activity in gold mining in the Eastern States in 1946. Individuals recovered 22 fine ounces of gold from placer mines in Georgia and Alabama. Gold was recovered as a byproduct from magnetite-pyrite-chalcopyrite ore from the Cornwall mine, Lebanon County, Pa.; from copper ore from the Elizabeth mine, Orange County, Vt.; and from copper-iron-zinc ore from the Tennessee Copper Co. mines, Polk County, Tenn. Output of gold in the Southern Appalachian States from 1799 to 1946 is estimated as follows:

Mine production of gold in the Southern Appalachian States, 1799–1946

State	Period	Fine ounces	Value	State	Period	Fine ounces	Value
Alabama	1830–1946	49,495	$1,198,985	South Carolina	1829–1946	318,801	$7,562,125
Georgia	1830–1946	870,547	18,084,992	Tennessee	1831–1946	20,965	481,405
Maryland	(1) –1946	6,102	163,940	Virginia	1828–1946	167,558	3,577,509
North Carolina	1799–1946	1,164,588	24,327,843	Total	1799–1946	2,598,056	55,396,799

[1] Year of first production not recorded.

Silver.—The mine output of silver in the Eastern States in 1946 comprised 35,275 fine ounces recovered from copper ore from Vermont, 18,016 ounces from copper-iron-zinc ore from Tennessee, 15,786 ounces from zinc-lead ore from New York, and 7,887 ounces from magnetite-pyrite-chalcopyrite ore from Pennsylvania.

Copper.—Production of recoverable copper in the Eastern States in 1946 totaled 25,700,000 pounds, a 3-percent increase over 1945. The Tennessee Copper Co., operating copper-iron-zinc mines in the Ducktown district of Tennessee, continued to be the leading producer of copper; the output from these mines increased slightly over 1945. Output by the Elizabeth mine, Orange County, Vt., operated by the Vermont Copper Co., increased sharply. The Bethlehem Steel Co. continued to recover copper as a byproduct in treating magnetite ore containing pyrite and chalcopyrite from the Cornwall mine in Lebanon County, Pa.

Lead.—Zinc-lead and zinc-iron-lead sulfide ores from the Austinville mine in Virginia and the Balmat in New York yielded the bulk of the Eastern States lead output in 1946; the rest was recovered from lead carbonate ore shipped from the Embree mine in Tennessee. The

total output was 5,579 tons compared with 5,159 tons in 1945.

Zinc.—Decreasing 11 percent annually the past 3 years, the mine output of recoverable zinc in the Eastern States dropped to 138,488 tons in 1946 from 199,233 tons in 1943. The decrease in 1946 was due largely to labor strikes, which shut down two mines in New Jersey for 2 months and five mines in Tennessee for 3 months; another contributing factor was exhaustion in January of the Shallow Ore open-pit ore body at New Market, Tenn. The New Jersey output of zinc decreased 21 percent and the Tennessee output 27 percent from 1945. In New York and Virginia zinc production increased 30 percent and 5 percent, respectively, as operations were nearly continuous and more men became available for work in the mines. Several of the large mines still received no Government premium for any part of their output, and only 7 percent of the total "mine" value of the zinc concentrates (calculated for all concentrates upon the basis of the average grade and value reported for the New York, Tennessee, and Virginia concentrates) represented premium payments for overquota production.

In the 4-year period 1942–45 the domestic mine output of zinc totaled 2,845,221 tons, and overceiling payments on zinc recorded by the Office of Price Administration amounted to $121,209,474. In the same period mines in the Eastern States produced 731,638 tons of zinc—26 percent of the total production—and received $4,084,118 (figures compiled from reports of mine operators)—only 3.4 percent of the total premium payments. The calculated premium per pound of zinc averaged 0.28 cent on the Eastern States output compared with 2.77 cents on the rest of the domestic output. In 1946 there was a general increase in premium payments to compensate the general wage increase; the payments on the Eastern States output averaged 0.38 cent per pound of zinc. The rise in the ceiling price from 8.25 to 9.25 cents October 14 and the advance in the market price to 10.50 cents upon removal of the ceiling November 11 raised materially the average total price received by Eastern States mines and improved the outlook for increased production and greater activity in prospecting and development.

MINE PRODUCTION BY STATES

Mine production of gold, silver, copper, lead, and zinc in the Eastern States in 1946, by States, in terms of recovered metals

State	Mines producing		Ore (short tons)	Gold			Silver (all lode)	
				Fine ounces		Total value	Fine ounces	Total value
	Lode	Placer		Lode	Placer			
Alabama		1			1	$35		
Georgia		4			21	735		
New Jersey	2		413,755					
New York	3		392,266				15,786	$12,755
Pennsylvania	1		(1)	1,150		40,250	7,887	6,373
Tennessee	14		1,812,919	95		3,325	18,016	14,557
Vermont	1		126,782	165		5,775	35,275	28,502
Virginia	1		490,278					
Total: 1946	22	5	[2] 3,236,000	1,410	22	50,120	76,964	62,187
1945 [3]	24		[2] 3,718,073	1,857		64,995	81,983	58,299

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in the Eastern States in 1946, by States, in terms of recovered metals—Continued

State	Copper		Lead		Zinc		Total value
	Pounds	Value	Short tons	Value	Short tons	Value	
Alabama							$35
Georgia							735
New Jersey					64,454	[4] $11,701,346	11,701,346
New York			1,073	$233,914	32,515	7,933,660	8,180,329
Pennsylvania	([5])	([5])					[5] 46,623
Tennessee	[5] 25,700,000	[5] $4,163,400	125	27,250	24,614	6,005,816	[5] 10,214,348
Vermont	([5])	([5])					[5] 34,277
Virginia			4,381	955,058	16,905	4,124,820	5,079,878
Total: 1946	25,700,000	4,163,400	5,579	1,216,222	138,488	29,765,642	35,257,571
1945 [3]	24,910,000	3,362,850	5,159	887,348	156,269	31,520,742	35,894,234

[1] Ore is magnetite-pyrite-chalcopyrite, flotation copper concentrates from which yielded gold, silver, and copper; Bureau of Mines not at liberty to publish figures for ore.
[2] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.
[3] No production from Georgia in 1945.
[4] Estimated smelting value of recoverable zinc content of ore after freight, haulage, smelting, and manufacturing charges are added.
[5] Data for copper in Pennsylvania and Vermont included with Tennessee; Bureau of Mines not at liberty to publish separate figures.

MINING INDUSTRY

With operations at some of the zinc mines interrupted by labor strikes, the quantity of zinc ore mined in the Eastern States decreased 31 percent in 1946 from 1945. The two mines producing zinc-lead ore operated steadily, and their combined output of ore increased 11 percent. The tonnage of straight lead ore mined was small. The output of copper ore increased 4 percent over 1945. The magnetite-pyrite-chalcopyrite ore mined in Pennsylvania, which yields copper, gold, and silver as byproducts, is classed as iron ore and is not included in the figures for crude ore given in the tables of this chapter. In the table on ore classification that follows, the copper recovered from the magnetite ore is included with that from copper ore, and the gold and silver are shown separately. No gold ore was reported mined in the Eastern States in 1946, but 22 ounces of gold were recovered from placer gravel. Most of the base-metal ores yield byproducts (besides gold and silver), the values of which are not shown in the tables of this chapter but would have to be considered to show the full value of the crude ore mined. The byproducts include pyrite concentrates (used in making sulfuric acid and iron sinter), sulfur dioxide gas (used in making sulfuric acid), produced in roasting sulfide concentrates, spiegeleisen, and mill tailings (used for agricultural lime, concrete, and other purposes). Mine development work and exploratory drilling reported by the companies decreased from 1945 in total footages for drifting and drilling and increased in the footage for shaft sinking. The Bureau of Mines continued to investigate sources of strategic minerals; the work done included diamond drilling (on copper deposits in Orange County, Vt.), field examinations, and tests of ore-treatment methods.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in the Eastern States in 1946, with content in terms of recovered metals

Source	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (short tons)	Zinc (short tons)
Copper ore	1,139,692	260	53,291	[1] 25,700,000	----------	[2]
Magnetite-pyrite-chalcopyrite ore	[3]	1,150	7,887	[1]	----------	----------
Zinc ore	1,342,233	----------	----------	----------	----------	96,986
Zinc-lead ore	[4] 754,075	----------	15,786	----------	5,579	[2] 41,502
Total, all lode mines	[5] 3,236,000	1,410	76,964	25,700,000	5,579	138,488
Placer	----------	22	----------	----------	----------	----------
Total: 1946	[5] 3,236,000	1,432	76,964	25,700,000	5,579	138,488
1945	[5] 3,718,073	1,857	81,983	24,910,000	5,159	156,269

[1] Copper from magnetite-pyrite-chalcopyrite ore included with that from copper ore.
[2] Zinc from copper ore included with that from zinc-lead ore; Bureau of Mines not at liberty to publish separate figures.
[3] Bureau of Mines not at liberty to publish separate figures for ore.
[4] Includes small tonnage of lead ore.
[5] Excludes magnetite-pyrite-chalcopyrite ore from Pennsylvania.

METALLURGIC INDUSTRY

The 4,000-ton Mascot mill in Knox County, Tenn.—equipped with a differential density (sink-and float) preliminary concentration unit, jigs, and flotation machines, and treating straight zinc ore—had the largest crude-ore capacity of any mill treating ores of copper, lead, or zinc in the Eastern States in 1946, although some of the mills treating higher-grade ore produced a larger tonnage of concentrates. The methods of treatment used in the mills and other operating details, including the tonnage and grade of the concentrates produced by some of the mills, are given in the Review by States that follows. Most of the concentrates were shipped to smelters operated by the companies that own the mines. No amalgamation or cyanidation mills were operated. Concentrates smelted (74,319 tons) yielded 1,410 ounces of gold and 76,964 ounces of silver; the tonnage of concentrates does not include material yielding no gold or silver. The total for concentrates (including low-grade concentrates shipped to oxide plants) was 534,003 tons. Direct-smelting ore (125,240 tons) treated was credited with no yield of gold or silver, as the quantity of these metals contained in the ore was very small and any recovery made would be accounted for in the gold and silver recovered from concentrates.

REVIEW BY STATES

ALABAMA

Gold dust containing about 1 ounce of fine gold was recovered by sluicing on the Hog Mountain mine property near Alexander City, Tallapoosa County.

GEORGIA

In 1946 individuals recovered a total of 21 fine ounces of gold from the Baggs Branch, Battle Branch, Consolidated, and Mill Creek

placers in Lumpkin County and the Kin Mori placer in Dawson County. The old Calhoun gold mine in Lumpkin County was under development by Calhoun Mines, Inc., which drove 530 feet of tunnel and 140 feet of drifts.

NEW JERSEY

Although the zinc mines in New Jersey were idle from June 17 to August 17 because of a labor strike, the State continued in 1946 to be the leading producer of zinc in the Eastern States and ranked third in the United States. The State output of recoverable zinc as metal or in oxide was 64,454 tons compared with 81,392 tons in 1945. Crude ore hoisted totaled 412,544 tons in 1946 compared with 516,225 tons in 1945. In addition to the crude ore milled, 1,211 tons of old tailings were remilled in 1946 and 5,952 tons in 1945. The operating mines in both years were the Mine Hill at Franklin and the Sterling Hill at Ogdensburg, Sussex County. The commercial ore minerals comprise chiefly franklinite (zinc-iron-manganese oxide) and willemite (zinc silicate) but also include zincite (red oxide of zinc). In reduction of the ore the franklinite is removed from the crushed ore by magnetic separators, and the willemite and zincite are concentrated on jigs and tables. The concentrates are shipped to smelting and manufacturing plants at Palmerton, Pa. The franklinite is used in the manufacture of zinc oxide and spiegeleisen, and the willemite-zincite concentrate is smelted to produce high-grade slab zinc.

The value of the New Jersey output of zinc given in the table of this chapter under the heading "Mine Production by States" is the combined value of the zinc recoverable in both metal and oxide after freight, haulage, smelting, and manufacturing charges are added.

Copper deposits in New Jersey were worked or prospected intermittently from Colonial days up to about 1912, and a little silver was reported recovered from some of the copper ore. Copper and lead smelters and refineries at Carteret and Perth Amboy treat ores, scrap, byproducts, and bullion from various States and foreign countries.

NEW YORK

Largely as the result of improvement in labor supply, zinc production in New York rose 30 percent and lead 24 percent in 1946 over 1945. The figures for recoverable metals were 32,515 tons of zinc and 1,073 tons of lead in 1946 compared with 24,978 and 862 tons, respectively, in 1945. The silver production, which is incidental to that of zinc and lead, was 15,786 ounces in 1946 and 14,271 ounces in 1945. The mines are in St. Lawrence County east and southeast of Gouverneur. The principal producers were the Balmat at Sylvan Lake and the Edwards at the town of Edwards, both owned and operated by the St. Joseph Lead Co. The Balmat is opened by a 2,907-foot, 40° inclined shaft, 252 feet of which were sunk in 1946. The ore contains zinc, iron, and lead sulfides, with some silver associated with the lead; it is treated in the 1,200-ton selective flotation mill at the mine. The mill is described in a recent publication.[1] The mill feed in 1946 totaled 262,197 tons; it yielded 1,795 tons of lead concentrates containing 61.01 percent lead and 11.28 ounces of silver

[1] Casale, James, St. Joe's Balmat Mill—Problem in Four Dimensions: Eng. and Min. Jour., vol. 147, No. 11, November 1946, pp. 56–62.

to the ton, 43,405 tons of zinc concentrates containing 57.26 percent zinc, and 54,467 tons of pyrite concentrates containing 41.69 percent iron and about 49 percent sulfur. The Edwards mine, equipped with a 600-ton flotation mill, was operated through a vertical shaft 1,560 feet deep and an underground shaft (inclined 42° from horizontal) 1,226 feet to the mine workings. Ore treated totaled 106,080 tons yielding 15,634 tons of zinc concentrates containing 59.15 percent zinc. The zinc concentrates from both mills were shipped to the company smelter at Josephtown, Pa.; the lead concentrates from the Balmat mill were shipped to the company Herculaneum, Mo., smelter. The pyrite concentrates were sold to sulfuric acid plants. The Universal Exploration Co. Hyatt mine, equipped with a 200-ton flotation mill, increased output in 1946 and was a substantial producer of zinc. The mine shaft is 450 feet deep. Development work in 1946 totaled 264 feet of drifts and 281 feet of diamond drilling. The concentrates were shipped to the Donora, Pa., smelter.

No commercial mine output of gold or copper in New York has been reported during the period covered by the annual mine canvass, which was begun in 1907. The Phelps Dodge Refining Corp. has a custom copper smelter and an electrolytic refinery at Laurel Hill, which treat copper ore, matte, bullion, and copper-bearing scrap material.

NORTH CAROLINA

North Carolina ordinarily produces gold, silver, and copper but had no output in 1945 or 1946. The Condor (old Howie) mine near Waxhaw, Union County, equipped with a 125-ton cyanidation mill, was the leading producer of gold in the State when war restrictions on gold mining caused it to shut down in October 1942. Reopening has been held in abeyance since the restrictions were removed July 1, 1945 because of high wage levels and scarcity of labor. An account of exploratory drilling by the Bureau of Mines at the Cline mine, Cabarrus County, has been published.[2]

PENNSYLVANIA

The gold, silver, and copper produced in Pennsylvania are by-products recovered in treating magnetite-pyrite-chalcopyrite ore from the Cornwall mine of the Bethlehem Steel Co., in Lebanon County. The ore is mined from an open pit and two underground mines. It is crushed to about 1-inch size at the mines in Cornwall and shipped in 70-ton hopper-bottom railroad cars to the treatment plants at Lebanon, which comprise a combined magnetic concentration and flotation mill and a sintering plant. The magnetic concentration equipment has a daily capacity of 6,000 tons, the flotation equipment 2,200 tons, and the sintering plant 2,400 tons. Part of the magnetic product is shipped to another sintering plant at Bethlehem. The flotation equipment treats tailings from the magnetic separators for the recovery of copper concentrates, which contain most of the gold and silver, and pyrite concentrates, which contain cobalt. The copper concentrates are shipped to a custom smelter and the pyrite concentrates to plants equipped for recovery of sulfur

[2] Beck, William A., Exploration at the Cline mine, Cabarrus County, N. C., Bureau of Mines Rept. of Investigations 3873, 1946, 4 pp.

(as sulfuric acid) and cobalt; the final pyrite residue is sintered and shipped to an iron and steel plant.

The zinc mines in Pennsylvania have been idle for many years. Zinc smelters at Donora, Langeloth, Josephtown, and Palmerton treat most of the zinc concentrates produced in the Eastern States, as well as large tonnages from the Central States and foreign countries. There is a roasting plant for concentrates at New Castle and an electrogalvanizing plant for sheets at Johnstown uses roasted zinc concentrates.

SOUTH CAROLINA

The Haile mine, Lancaster County, leading producer of gold in South Carolina and the Eastern States from 1938 to 1942, was shut down in September 1942 because of the diminishing supply of labor and materials available for gold mining under war conditions. The mine, equipped with a 400-ton cyanide mill, is owned by the Haile Gold Mines, Inc. The company reported at the end of 1946 that the date of reopening depends entirely upon labor conditions.

TENNESSEE

Zinc production in Tennessee in 1946 (the lowest since 1936) totaled 24,614 tons, in terms of recoverable metal, compared with 33,824 tons in 1945. The decrease was caused by the labor strike lasting from February 2 to May 6 at the American Zinc Co. mines in Knox and Jefferson Counties and exhaustion in January of the company Shallow Ore open-pit ore body at New Market. The output of lead was 125 tons compared with 54 tons in 1945. Gold production decreased from 148 fine ounces in 1945 to 95 ounces in 1946 and silver from 35,391 to 18,016 ounces. Copper production increased slightly in 1946.

The gold, silver, and copper and considerable zinc came from the Tennessee Copper Co. Burra Burra, Boyd, Calloway, and Eureka mines at Ducktown, Polk County. The ore was mined at depths ranging from 750 to 2,400 feet and hoisted through vertical shafts. Development work done at the 4 mines in 1946 totaled 93 feet of shaft, 9,084 feet of drifts, and 6,927 feet of diamond drilling. The ore contains heavy sulfides of iron, copper, and zinc; most of that mined in 1946 was concentrated by selective flotation in the London and Isabella mills, which together had a combined daily capacity of 3,000 tons at the end of the year. Some of the ore was smelted direct in a blast furnace in the company smelter at Copperhill. The copper concentrates from the mills were smelted in a reverberatory furnace. The matte from the reverberatory and blast furnaces was treated in a converter. Part of the blister copper from the converter was cast into pigs and shipped to an electrolytic refinery on the Atlantic seaboard where some gold and silver were recovered. Production of shot copper (used in making copper sulfate in the plant adjoining the smelter) increased in 1946; as a result, more of the gold and silver accumulated in the shot copper residue, and less was available for sale than in 1945. The iron concentrates were used in making sulfuric acid in the company plants at Copperhill and Isabella; they also yielded iron sinter, which was sold to iron and steel plants. Sulfur dioxide gas from the blast furnace and copper converter was also used in making sulfuric acid.

The zinc concentrates were sold to custom smelters. Smelter slag was screened and sized for sale, mostly as railroad ballast, road material, concrete aggregate, and roofing granules.

Most of the State zinc output comes from the Mascot-New Market-Jefferson City or East Tennessee district in Knox and Jefferson Counties. The district production in 1946 was the lowest since 1935. The American Zinc Co. Mascot No. 2, Mascot Graves, Grasselli, Jarnagin, and Mossy Creek mines were shut down from February 2 to May 6 by a labor strike. The company Shallow Ore open-pit mine was closed in January owing to exhaustion of the ore body; its total output from the beginning of operations in October 1943 through January 1946 was 812,565 tons of crude ore yielding 26,413 tons of concentrates averaging 60.92 percent zinc. The Mascot mines are worked through a 520-foot vertical shaft and an inclined shaft from the 520-foot level to the maximum depth of 850 feet. The Grasselli ore-hoisting shaft is 350 feet deep, and the Jarnagin shaft is 280 feet deep. The Mossy Creek mine is opened by 249-foot incline shaft. The ore from all five mines was concentrated in the 4,000-ton mill at the Mascot No. 2 mine. The mill is equipped with a differential-density (sink-and-float) cone unit, jigs, and flotation machines. Ore treated in 1946 totaled 569,862 tons yielding 26,176 tons of 61.57-percent zinc concentrates compared with 1,119,569 tons in 1945 yielding 45,520 tons of 61-percent concentrates. The mill tailings, chiefly limestone, are sent to the byproduct plant to be prepared for sale as railroad ballast, commercial stone, sand, or a pulverized product. Data extracted from the annual company report to stockholders follow. Surface drilling done during the year totaled 49,794 feet, underground drilling 10,407 feet, and drifting, raising, and slabbing 5,043 feet. Surface drilling results were very satisfactory. Mineral rights were purchased on additional Jefferson County properties. Ore reserves on company-owned properties in Knox and Jefferson Counties were reduced by approximately 8,023 tons of concentrates. Ore reserves on the Grasselli property were increased 16,656 tons of concentrates, making a net gain in ore reserves of 8,633 tons of concentrates. The total reserves at the end of 1946 were the highest ever recorded.

The Universal Exploration Co. Davis-Bible group of mines and 800-ton flotation mill near Jefferson City operated continuously in 1946. The output of concentrates increased over 1945. The grade of the concentrates is exceptionally high; those shipped from 1930 through 1946 averaged 64.58 percent zinc. Two shafts 180 and 240 feet deep were operated. Development during the year totaled 1,048 feet of drifts, 1,430 feet of diamond drilling, and 9,377 feet of churn drilling. The mill is equipped with crushers, rod mills, and flotation machines. The mill tailings are sold, mostly for use as agricultural lime. The company shipped ore from the Straight Creek mine near New Tazewell, Claiborne County, in November and December but abandoned the property December 16. Data on some of the Bureau of Mines exploratory drilling in this county have been published.[3] The Tennessee Zinc Co. operated the Embreeville group in Washington and Unicoi Counties. The ore was concentrated by washing,

[3] Sayrs, Richard L., Exploration of Stiner and Bunch Hollow Zinc Properties, Powell River Area, Union and Claiborne Counties, Tenn.: Bureau of Mines Rept. of Investigations 3856, 1946, 4 pp.

jigging, tabling, and drying. Most of the concentrate output was zinc carbonate; the rest was lead carbonate. The company sank a 140-foot shaft and drove 500 feet of tunnel during the year. In Cannon County the Hoover (Gaither) mine east of Murfreesboro, equipped with a 25-ton mill, continued to produce about a car of zinc sulfide concentrates monthly.

VERMONT

The Vermont Copper Co. operated the Elizabeth mine and 500-ton flotation mill in Orange County throughout 1946. The output of copper increased sharply over 1945. Revised figures on mine-development footage show that the haulage adit is 1,300 feet long and that the underground 30° inclined shaft opening up working levels on the vein is 825 feet long. Sinking of another shaft 450 feet on a 60° incline was completed in 1946. Other development done during the year included 2,163 feet of drifts and crosscuts, 348 feet of raises, and 1,355 feet of diamond drilling. The ore minerals are chalcopyrite and pyrrhotite, carrying some silver and a little gold. The concentrates produced averaged 23.50 percent copper (wet assay) and 0.013 ounce of gold and 2.73 ounces of silver to the ton; they were shipped to the Phelps Dodge smelter at Laurel Hill, N. Y. The Bureau of Mines did diamond drilling at the Ely mine near South Strafford during September and October.

VIRGINIA

The output of recoverable zinc in Virginia was 16,905 tons and of lead 4,381 tons in 1946 compared with 16,075 and 4,243 tons, respectively, in 1945. The Austinville mine, Wythe County, which has been in continuous operation since 1924, operated at a slightly higher average monthly rate than in 1945; the ore is treated in a 2,000-ton flotation mill at the mine. No output of gold, silver, or copper was reported in the State in 1946. The Toncrae Mining Co. reported progress on constructing a plant to heap-roast and leach ore and precipitate copper at the Toncrae mine, Floyd County.

Idaho
Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By C. E. NEEDHAM AND PAUL LUFF

	PAGE		PAGE
General summary	1424	Metallurgic industry	1432
Calculation of value of metal production	1425	Review by counties and districts	1436
Mine production by counties	1430	Coeur d'Alene region	1442
Mining industry	1431		
Ore classification	1431		

GENERAL SUMMARY

UNLIKE other Western States, Idaho was not affected by a serious labor strike in 1946; but it was still plagued by a shortage of labor, which caused further declines in the output of silver, lead, zinc, and copper. However, the output of gold in Idaho increased greatly in 1946, owing principally to resumption of dredging at placer properties after being closed since October 8, 1942, when War Production Board Order L–208 suspended nearly all gold mining. In 1946 the State output of gold rose to 42,975 fine ounces from 17,780 fine ounces in 1945. The output of silver declined from 8,142,667 fine ounces to 6,491,104 (20 percent); copper, from 3,096,000 pounds to 2,076,000 (33 percent); lead, from 136,894,000 pounds to 119,974,000 (12 percent); and zinc, from 166,926,000 pounds to 143,014,000 (14 percent). The output of gold in 1946 was the largest for any year since 1942; silver, the smallest since 1922; copper, the smallest since 1934; lead, the smallest since 1899; and zinc, the smallest since 1940. However, the State remained the largest producer of silver and zinc in the United States and the second largest producer of lead (exceeded only by Missouri). The total value of the gold was $1,504,125—4 percent of the State total value; silver, $5,244,812—14 percent; copper, $336,312—1 percent; lead, $13,077,166—35 percent; and zinc, $17,447,708—46 percent. The total value of the five metals was $37,610,123 in 1946 compared with $37,799,975 in 1945. About 87 percent of the State silver production, 78 percent of the copper, 94 percent of the lead, and 94 percent of the zinc came from the Coeur d'Alene region of Shoshone County; the rest of the silver, copper, lead, and zinc came largely from the Warm Springs district in Blaine County.

Nearly 87 percent of the State gold production came from the Yellow Pine district in Valley County, Middle Boise (Atlanta) district in

Elmore County, Boise Basin district in Boise County, Yankee Fork district in Custer County, and Warm Springs district in Blaine County.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1942–46

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1942	$35.00	$0.711+	$0.121	$0.067	$0.093
1943	35.00	.711+	.130	.075	.108
1944	35.00	.711+	.135	.080	.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+($20.671835) per fine ounce.

[2] Treasury buying price for newly mined silver. 1942 to June 30, 1946: $0.71111111; July 1 to Dec. 31, 1946: $0.905.

[3] Yearly average weighted price of all grades of primary metal sold by producers; price includes bonus payments by Office of Metals Reserve for overquota production.

Mine production of gold, silver, copper, lead, and zinc in Idaho, 1942–46, and total, 1863–1946, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1942	203	236	2,900,704	95,020	$3,325,700	14,644,890	$10,414,144
1943	127	30	2,741,747	30,808	1,078,280	11,700,180	8,320,128
1944	112	20	3,271,038	25,008	875,280	9,931,614	7,062,481
1945	116	27	3,139,286	17,780	622,300	8,142,667	5,790,341
1946	139	71	2,882,187	42,975	1,504,125	6,491,104	5,244,812
1863–1946			[1]	7,840,749	177,565,618	520,485,412	359,031,993

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1942	6,860,000	$830,060	227,818,000	$15,263,806	174,512,000	$16,229,616	$46,053,326
1943	4,648,000	604,240	192,914,000	14,468,550	173,414,000	18,728,712	43,199,910
1944	3,376,000	455,760	167,060,000	13,364,800	182,744,000	20,832,816	42,591,137
1945	3,096,000	417,960	136,894,000	11,772,884	166,926,000	19,196,490	37,799,975
1946	2,076,000	336,312	119,974,000	13,077,166	143,014,000	17,447,708	37,610,123
1863–1946	[2] 107,787	32,957,079	[2] 5,940,384	655,878,268	[2] 1,293,672	211,228,625	1,436,661,583

[1] Figure not available.

[2] Short tons.

Gold produced at placer mines in Idaho, 1942–46, by classes of mines and by methods of recovery

Class and method	Mines producing	Material treated (cubic yards)	Gold recovered		
			Fine ounces	Value	Average per cubic yard
Surface placers:					
Gravel mechanically handled:					
Connected-bucket dredges:					
1942	10	7,772,947	36,611	$1,281,385	$0.165
1943–1944					
1945	1	250,000	1,593	55,755	.223
1946	7	3,766,746	17,448	610,680	.162
Dragline dredges:					
1942	7	1,100,575	6,126	214,410	.195
1943–1945					
1946	6	364,260	2,272	79,520	.218
Nonfloating washing plants: [1]					
1942	5	75,362	563	19,705	.261
1943–1946					
Sluicing and hydraulicking:					
1942	202	139,650	1,197	41,895	.300
1943	29	29,050	249	8,715	.300
1944	16	13,767	118	4,130	.300
1945	23	19,600	168	5,880	.300
1946	53	44,450	381	13,335	.300
Underground placers:					
Drift:					
1942	14	9,683	83	2,905	.300
1943	1	700	6	210	.300
1944	4	2,100	18	630	.300
1945	3	933	8	280	.300
1946	5	2,567	22	770	.300
Grand total placer:					
1942	238	9,098,217	44,580	1,560,300	.171
1943	30	29,750	255	8,925	.300
1944	20	15,867	136	4,760	.300
1945	27	270,533	1,769	61,915	.229
1946	71	4,178,023	20,123	704,305	.169

[1] Includes all placer operations using power excavator and washing plant, both on dry land; an outfit with movable washing plant is termed a "dry-land dredge."

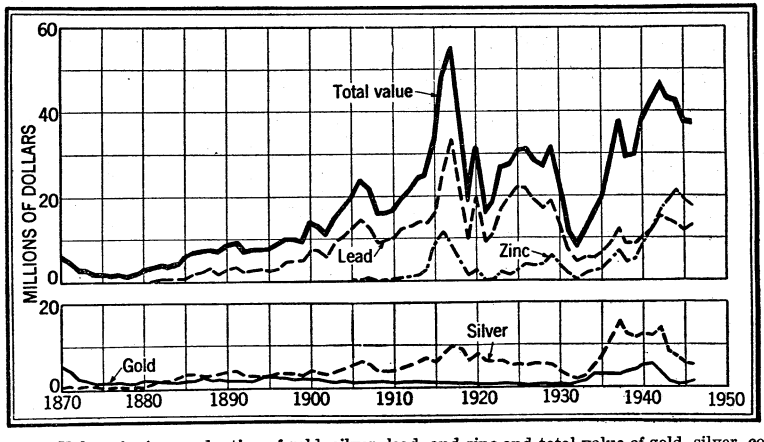

FIGURE 1.—Value of mine production of gold, silver, lead, and zinc and total value of gold, silver, copper, lead, and zinc in Idaho, 1870–1946. The value of copper has been less than $2,000,000 annually, except in a few years.

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1946, by months, in terms of recovered metals

	Gold (ounces)	Silver (ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
January	1,100	420,000	140,000	11,900,000	13,000,000
February	720	505,000	176,000	11,400,000	12,700,000
March	1,880	525,000	174,000	11,900,000	14,000,000
April	2,000	455,000	150,000	11,100,000	12,300,000
May	5,400	454,104	120,000	9,600,000	11,500,000
June	5,580	440,000	180,000	8,066,000	11,600,000
July	5,750	505,000	180,000	8,500,000	10,600,000
August	5,570	557,000	180,000	9,100,000	11,200,000
September	3,650	510,000	178,000	9,100,000	11,100,000
October	2,750	510,000	172,000	9,150,000	11,414,000
November	3,750	592,000	230,000	9,150,000	11,500,000
December	4,825	1,018,000	196,000	11,008,000	12,100,000
Total 1946	42,975	6,491,104	2,076,000	119,974,000	143,014,000

Gold.—Despite an increase of 142 percent in output of recoverable gold from mines in Idaho in 1946 compared with 1945, the output was far below that during the years before the war. The yield of gold from lode mines increased from 16,011 ounces in 1945 to 22,852 in 1946 and that from placer properties from 1,769 ounces to 20,123. This marked increase in output of gold from placer properties resulted principally from resumption, during the spring months of 1946, of dredging in the Boise Basin, Yankee Fork, Middle Boise, Elk City, Orogrande, and Gibbonsville districts. Seven bucket dredges and six dragline dredges treated about 4,131,000 cubic yards of gravel in 1946 and recovered 19,720 fine ounces of gold and 6,370 fine ounces of silver. The Bradley Mining Co., operating the Yellow Pine mine at Stibnite, treated more gold-silver-antimony ore in its flotation plant in 1946 than in 1945 and became the largest producer of gold in Idaho. The Talache Mines, Inc., operating a lode property at Atlanta, ranked second in gold output and was followed by the Snake River Mining Co. (bucket dredge) at Sunbeam, Baumhoff & Marshall (formerly Fisher-Baumhoff Co.) (two bucket dredges) near Centerville, Pyramid Mining Co. (bucket dredge) near Twin Springs, Triumph mine at Triumph, Idaho-Canadian Dredging Co. (bucket dredge) at Idaho City, and Smith Bros. & Courtis, Inc. (dragline dredge) near Gibbonsville. Of the total gold produced in Idaho in 1946, more than 40 percent came from bucket dredging, 39 percent from gold ore, 13 percent from zinc-lead ore, and most of the remainder from dragline dredging.

Silver.—Idaho's production of recoverable silver has dropped every year except 1940 since 1937; the largest production was in 1937, when 19,587,766 fine ounces were produced. In 1946 the output was 6,491,104 fine ounces compared with 8,142,667 fine ounces in 1945; nevertheless, the State remained the largest producer of silver in the United States—a place it has held since 1933. The loss in 1946 resulted mainly from a decline in output of zinc-lead-silver ore from mines in the Coeur d'Alene region and from the after effects of a fire in December 1945 in the Sunshine mine—also in the Coeur d'Alene region. Large decreases in silver output were reported by the Sun-

shine Mining Co., Bunker Hill & Sullivan Mining & Concentrating Co., Federal Mining & Smelting Co., (Morning mine), operators of the Osburn tailing plant, Sherman Lead Co., Monitor Mining Co., Triumph Mining Co., Clayton Silver Mines, Tamarack & Custer Consolidated Mining Co., and Sullivan Mining Co. (Star mine); however, a marked increase was made at the Page mine of the Federal Mining & Smelting Co. and at the Yellow Pine mine of the Bradley Mining Co. The Coeur d'Alene region produced 87 percent of the State total silver in 1946; the remainder came largely from the Warm Springs, Bayhorse, Deadwood Basin, Yellow Pine, and Blue Wing districts. Of the State total silver, zinc-lead ore and old tailings yielded 53 percent, silver ore 40 percent, lead ore 4 percent, and gold ore, zinc slag, and lead-copper ore nearly all the remainder. The recovery of silver from silver ore decreased 970,800 ounces, owing chiefly to the decline in output of ore from property operated by the Sunshine Mining Co.; and the recovery of silver from zinc-lead ore decreased 534,159 ounces owing to a decline in output of zinc-lead ore from most of the principal producers, but the recovery of silver from gold ore more than doubled that in 1945, as a result of more gold ore being mined at two properties in Elmore and Valley Counties.

Ten mines—the Sunshine, Polaris, Bunker Hill & Sullivan, Silver Dollar, Osburn tailing plant, Triumph, Page, Morning, Star, and Sweeny tailing dump—produced 75 percent of the silver output of the State in 1946. All but the Triumph are in the Coeur d'Alene region.

Copper.—The output of copper in Idaho continued to decline and dropped to 2,076,000 pounds in 1946. About 78 percent of the State copper output in 1946 was recovered as a byproduct in the treatment of zinc-lead ore, silver ore, silver-copper-antimony ore, and lead ore from mines in the Coeur d'Alene region; the remainder was recovered largely from zinc-lead ore produced in the Warm Springs district, silver-tungsten ore in the Blue Wing district, zinc-lead ore in the Deadwood Basin district, and copper ore in the Alder Creek district.

The Osburn tailing plant at Osburn in the Coeur d'Alene region was the largest producer of copper in Idaho in 1946. It was followed by the Sunshine, Triumph, and Polaris properties.

Lead.—The output of recoverable lead in Idaho has been dropping steadily since 1942, and the output in 1946 (119,974,000 pounds) was the smallest since 1899; however, the value of the output was $1,304,282 more than in 1945, owing to an increase in the average price of the metal. The loss in quantity resulted principally from a decline in output of zinc-lead-silver ore and silver-lead ore from mines in the Coeur d'Alene region, caused by a shortage of underground labor. Marked decreases in lead output in 1946 were reported by the operators of Osburn tailing plant, Federal Mining & Smelting Co. (Morning mine), Sherman Lead Co., Sunshine Mining Co., Bunker Hill & Sullivan Mining & Concentrating Co., Triumph Mining Co., Monitor Mining Co., and Clayton Silver Mines; however, substantial increases were made at the Page, Sidney, and Liberal King properties. About 94 percent of the State total lead came from the Coeur d'Alene region; most of the remainder was produced in the Warm Springs, Bayhorse,

Deadwood Basin, Dome, Texas, and Alder Creek districts. Zinc-lead ore and old tailings (2,296,768 tons) from the Coeur d'Alene region yielded 82 percent of the State total lead, and lead ore and silver ore, chiefly from the Coeur d'Alene region, yielded 10 percent; the remainder came largely from zinc-lead ore in the Warm Springs district and from old zinc slag in the Coeur d'Alene region. Lead recovered from zinc-lead ore and old tailings decreased 14,744,219 pounds and that from silver ore 2,347,181 pounds, but lead from zinc ore and old slag increased 151,623 pounds and that from lead ore 10,771 pounds.

In 1946 the combined lead output of the five largest producing mines—the Bunker Hill & Sullivan, Page, Star, Osburn tailing plant, and Morning—was 62,646,295 pounds, 52 percent of the State total. In 1945 the combined lead output of these properties was 70,131,690 pounds. Other important producers in 1946 were the Sweeny tailing dump, Tamarack, Bunker Hill slag dump, Triumph, Sherman, Frisco, Dayrock, and Sidney properties.

Zinc.—Although Idaho's output of recoverable zinc declined to 143,014,000 pounds in 1946, the State continued to be the largest producer of zinc in the United States, and the output in 1946 again exceeded the lead output. Idaho reached its peak production of zinc in 1944, when 182,744,000 pounds were produced. Marked decreases in output of zinc in 1946 at the Morning, Osburn tailing plant, Monitor, Tamarack, Bunker Hill & Sullivan, Frisco, Triumph, Little Pittsburg, and Star properties more than offset substantial increases at the Page, Spokane-Idaho, White Knob, Sidney, and Liberal King properties. More than 94 percent of the State total zinc in 1946 came from the Coeur d'Alene region and nearly all the remainder from the Warm Springs, Alder Creek, Deadwood Basin, Lava Creek, Bayhorse, and Mineral Hill & Camas districts. Zinc-lead ore and old tailings concentrated yielded 85 percent of the State total zinc; old zinc slag smelted and fumed, 12 percent; and zinc ore smelted, zinc ore concentrated, lead ore concentrated, silver ore concentrated, and zinc-lead ore smelted nearly all the remainder.

Eleven properties—the Star, Bunker Hill smelter slag dump, Osburn tailing plant, Page, Morning, Tamarack, Frisco, Bunker Hill & Sullivan mine, Monitor, Spokane-Idaho, and Triumph—produced 77 percent of the State total zinc in 1946.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1946, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Adams	1		4	$140	172	$139
Benewah		1	14	490		
Blaine	11		3,674	128,590	447,807	361,828
Boise	11	14	7,809	273,315	3,484	2,815
Bonner	3		8	280	20,135	16,269
Bonneville		1	47	1,645		
Boundary	1		1	35	1,646	1,330
Butte	3		19	665	5,979	4,831
Camas	1	1	32	1,120	16	13
Clark	1				47	38
Clearwater		1	121	4,235	42	34
Custer	19	1	5,408	189,280	109,448	88,434
Elmore	3	4	9,700	339,500	28,562	23,078
Gem	3	2	54	1,890	1,354	1,094
Idaho	6	22	1,507	52,745	318	257
Jerome		3	29	1,015		
Lemhi	12	8	1,616	56,560	58,183	47,012
Nez Perce		1	8	280		
Owyhee	4	4	45	1,575	182	147
Power		1	1	35		
Shoshone	56	1	1,758	61,530	5,655,672	4,569,783
Twin Falls		3	13	455		
Valley	3	3	11,107	388,745	158,031	127,689
Washington	1				26	21
Total: 1946	139	71	42,975	1,504,125	6,491,104	5,244,812
1945	116	27	17,780	622,300	8,142,667	5,790,341

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Adams	13,500	$2,187					$2,466
Benewah							490
Blaine	217,500	35,235	3,537,000	$385,533	4,933,000	$601,826	1,513,012
Boise			200	22			276,152
Bonner	1,500	243	71,000	7,739	18,000	2,196	26,727
Bonneville							1,645
Boundary	1,500	243	87,000	9,483	8,000	976	12,067
Butte	5,000	810	485,000	52,865	133,000	16,226	75,397
Camas							1,133
Clark			19,800	2,158			2,196
Clearwater							4,269
Custer	80,000	12,960	1,589,000	173,201	2,053,000	250,466	714,341
Elmore							362,578
Gem			600	65	1,600	195	3,244
Idaho							53,002
Jerome							1,015
Lemhi	85,000	13,770	440,400	48,004	31,400	3,831	169,177
Nez Perce							280
Owyhee							1,722
Power							35
Shoshone	1,619,000	262,278	113,096,000	12,327,464	134,858,000	16,452,676	33,673,731
Twin Falls							455
Valley	53,000	8,586	644,000	70,196	978,000	119,316	714,532
Washington			4,000	436			457
Total: 1946	2,076,000	336,312	119,974,000	13,077,166	143,014,000	17,447,708	37,610,123
1945	3,096,000	417,960	136,894,000	11,772,884	166,926,000	19,196,490	37,799,975

MINING INDUSTRY

In spite of higher prices for silver, copper, lead, and zinc in 1946, base-metal mining in Idaho continued to decline, not because of labor strikes, as in some Western States, but principally because of a shortage of underground labor. The large producers of zinc-lead-silver ore and silver-lead ore in the Coeur d'Alene region, Shoshone County—the chief source of silver, copper, lead, and zinc in Idaho—were required to curtail operations with such an inadequate supply of labor. However, gold mining in Idaho, especially bucket dredging and dragline dredging at placer properties, made a substantial recovery in 1946 after sharply curtailed activity since October 8, 1942, when War Production Board Order L–208 suspended nearly all gold mining. The number of bucket dredges increased from one in 1945 to seven in 1946 and the number of dragline dredges from none to six. The output of zinc-lead ore and old tailings (by far the chief ore output of the State) decreased from 2,687,912 tons to 2,407,404, siliceous silver ore from 122,094 tons to 92,209, and copper ore from 8,569 tons to 903; but siliceous gold ore increased from 113,030 tons to 163,666, lead ore from 107,511 tons to 113,175, and zinc ore and old slag from 100,039 tons to 104,585. Nearly all the gold ore mined in Idaho in 1946 came from two properties—one in the Middle Boise district, Elmore County, and the other in the Yellow Pine district, Valley County; 64 percent of the silver ore, 92 percent of the lead ore, 95 percent of the zinc ore and old slag, and 95 percent of the zinc-lead ore and old tailings came from various properties in the Coeur d'Alene region and nearly all of the copper ore from one mine in the Alder Creek (Mackay) district.

ORE CLASSIFICATION

Details on ore classification are given in the Gold and Silver chapter of this volume.

Ore sold or treated in Idaho in 1946, with content in terms of recovered metals

Source	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	28	163,666	16,847	105,383	361	288	----------
Dry and siliceous gold-silver ore	9	126	110	3,990	----------	400	----------
Dry and siliceous silver ore	12	92,209	70	2,610,389	720,040	4,003,300	237,587
	49	256,001	17,027	2,719,762	720,401	4,003,988	237,587
Copper ore	3	903	60	1,086	53,275	----------	----------
Lead ore	31	113,175	107	264,279	36,805	8,287,636	622,724
Lead-copper ore	1	119	1	18,154	9,345	36,850	----------
Zinc ore	6	[1] 104,585	40	39,614	17,080	3,454,623	20,117,230
Zinc-lead ore	58	2,407,404	5,617	3,441,787	1,239,094	104,190,903	122,036,459
Total lode mines	[2] 139	[1] 2,882,187	22,852	6,484,682	2,076,000	119,974,000	143,014,000
Placers	71	----------	20,123	6,422	----------	----------	----------
Total: 1946	210	[1] 2,882,187	42,975	6,491,104	2,076,000	119,974,000	143,014,000
1945	143	[3] 3,139,286	17,780	8,142,667	3,096,000	136,894,000	166,926,000

[1] Includes 92,072 tons of old lead-smelter slag.
[2] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[3] Includes 92,266 tons of old lead-smelter slag.

METALLURGIC INDUSTRY

Of the 2,882,187 tons of ore produced in 1946 in Idaho, 2,757,813 tons (95 percent) were treated at concentration plants, 108,667 tons (4 percent) were shipped crude to smelters, and 15,707 tons (nearly 1 percent) were treated at amalgamation mills.

Concentration plants in 1946 treated 147,505 tons of gold ore, 91,959 tons of silver ore, 105,682 tons of lead ore, 6,908 tons of zinc ore, and 2,405,759 tons of zinc-lead ore and old tailings. Current hot zinc slag totaling 140,044 tons was fumed, and 92,072 tons of old dump lead-smelter slag were delivered for smelting and fuming in 1946. Metals recovered from the old dump slag were credited to the Bunker Hill smelter dump, and metals recovered from the hot slag were credited to various producers of the ores and concentrates that contributed during the year to the slag-making material.

Ore treated at straight amalgamation mills in 1946 totaled 262 tons and that at combined amalgamation and concentration plants 15,445 tons; none was treated at cyanidation plants.

The Bunker Hill & Sullivan Mining & Concentrating Co. operated its Bradley lead smelter and refinery at a lower rate than in 1945 on ore and concentrates, chiefly from mines and mills in the Coeur d'Alene region. The company also operated its antimony and cadmium plants, 1,700-ton flotation mill (including a sink-and-float unit), 300-ton tailing-treatment plant for recovery of silver, iron, and lead from old jig tailings, and 450-ton zinc slag-fuming plant at Bradley. According to the company annual stockholders' report for 1946, the smelter produced 2,271 ounces of gold, 4,127,943 ounces of silver, 147,055 pounds of cadmium, 625 tons of copper, 463 tons of antimony, 15,013 tons of zinc, and 33,669 tons of lead. The slag-fuming plant yielded 22,579 dry tons of deleaded zinc fume and 3,936 dry tons of lead fume; the production of lead in 1946 was more than double that in 1945, but the production of zinc was nearly 2,000,000 pounds less. The Sullivan Mining Co. operated continuously its 100-ton electrolytic zinc plant near Bradley, but had to inactivate 150 of its 450 cells because of a labor shortage during a large part of the year; however, increased manpower during the last weeks of the year permitted full operations. The Bradley Mining Co. operated its flotation mill at Stibnite, Valley County, 8 months of the year principally on gold-silver-iron-antimony ore; in September and October the mill re-treated old stock-piled tungsten concentrate. By adding a rod mill in October the capacity of the mill was increased from 800 tons of ore a day to 1,800 tons a day. Tungsten concentrates and silver-copper-lead-iron concentrates were produced throughout the year in the Ima mill at Patterson, Lemhi County.

Mine production of metals in Idaho in 1946, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore amalgamated	15,707	2,919	1,766			
Concentrates smelted	233,364	18,811	6,357,673	1,981,943	114,965,683	123,395,883
Ore smelted	108,667	1,122	125,243	94,057	5,008,317	19,618,117
Placer		20,123	6,422			
Total: 1946		42,975	6,491,104	2,076,000	119,974,000	143,014,000
1945		17,780	8,142,667	3,096,000	136,894,000	166,926,000

Mine production of metals from amalgamation mills (with or without concentration equipment) in Idaho in 1946, by counties, in terms of recovered metals

County	Material treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal		
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)
Boise	206	73	41	1	5	2
Elmore	14,523	2,790	1,697	409	2,281	22,371
Idaho	106	35	10			
Owyhee	872	21	18	1	3	3
Total: 1946	15,707	2,919	1,766	411	2,289	22,376
1945	1,930	373	203	28	98	3,818

Mine production of metals from concentrating mills in Idaho in 1946, by counties, in terms of recovered metals

County	Ore treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Blaine	77,534	13,488	3,630	444,620	216,465	3,506,181	4,879,588
Bonner	2,880	149	8	17,661	1,300	71,000	18,000
Boundary	3,845	87	1	1,646	1,500	87,000	8,000
Butte	4,651	680	14	4,380	4,243	484,320	133,000
Custer	12,682	1,206	27	52,584	9,000	980,240	323,895
Gem	11	3	4	66		600	1,600
Lemhi	30,845	952	17	49,373	79,000	104,850	
Shoshone	2,461,510	208,055	1,730	5,607,204	1,617,435	109,087,692	117,053,800
Valley	163,855	8,333	11,091	157,763	53,000	643,800	978,000
Total: 1946	2,757,813	232,953	16,522	6,335,297	1,981,943	114,965,683	123,395,883
1945	3,027,500	270,281	14,038	7,996,821	2,661,723	131,781,728	148,778,579

Gross metal content of concentrates produced from ores mined in Idaho in 1946, by classes of concentrates smelted

Class of concentrates	Concentrates produced (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	7,252	13,127	100,207			
Copper	183	6	75,329	95,906		
Lead	76,308	2,640	2,857,102	827,067	93,915,813	12,602,310
Lead-copper	7,884	273	2,492,139	724,266	4,372,719	375,880
Zinc	115,547	1,215	534,484	465,104	9,049,748	117,606,481
Zinc-lead	21,990	250	281,350	107,413	9,733,998	4,974,236
Dry iron (from zinc ore and zinc-lead ore)	4,200	1,300	17,062	18,548	116,361	171,629
Total: 1946	233,364	18,811	6,357,673	2,238,304	117,188,639	135,730,536
1945	270,309	14,144	8,003,389	3,035,648	134,485,973	156,694,746

Mine production of metals from Idaho concentrates shipped to smelters in 1946, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Blaine	13,488	3,630	444,620	216,465	3,506,181	4,879,588
Boise	1	5	2			
Bonner	149	8	17,661	1,300	71,000	18,000
Boundary	87	1	1,646	1,500	87,000	8,000
Butte	680	14	4,380	4,243	484,320	133,000
Custer	1,206	27	52,584	9,000	980,240	323,895
Elmore	409	2,281	22,371			
Gem	3	4	66		600	1,600
Lemhi	952	17	49,373	79,000	104,850	
Owyhee	1	3	3			
Shoshone	208,055	1,730	5,607,204	1,617,435	109,087,692	117,053,800
Valley	8,333	11,091	157,763	53,000	643,800	978,000
Total: 1946	233,364	18,811	6,357,673	1,981,943	114,965,683	123,395,883
1945	270,309	14,136	8,000,639	2,661,723	131,781,728	148,778,579

BY CLASSES OF CONCENTRATES

Dry gold	7,252	13,127	100,207			
Copper	183	6	75,329	92,730		
Lead	76,308	2,640	2,857,102	698,380	92,381,382	9,944,853
Lead-copper	7,884	273	2,492,139	654,605	4,276,980	302,587
Zinc	115,547	1,215	534,484	427,574	8,652,020	108,879,639
Zinc-lead	21,990	250	281,350	91,485	9,562,212	4,257,070
Dry iron (from zinc ore and zinc-lead ore)	4,200	1,300	17,062	17,169	93,089	11,734
Total 1946	233,364	18,811	6,357,673	1,981,943	114,965,683	123,395,883

Gross metal content of Idaho crude ore shipped to smelters in 1946, by classes of ore

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	454	801	3,410	422	480	
Dry and siliceous gold-silver	126	110	3,990		473	
Dry and siliceous silver	250	8	6,148	1,465	17,343	2,594
Copper	903	60	1,086	55,193		
Lead	7,493	61	36,667	8,592	1,362,060	104,159
Lead-copper	119	1	18,154	11,097	38,013	5,000
Zinc	[1] 97,677	28	33,627	16,801	3,461,360	24,425,316
Zinc-lead	1,645	53	22,161	10,986	347,440	329,935
Total: 1946	[1] 108,667	1,122	125,243	104,556	5,227,169	24,867,004
1945	[2] 109,856	1,502	141,420	450,726	5,301,301	22,765,175

[1] Includes 92,072 tons of old lead-smelter slag smelted and fumed.
[2] Includes 92,266 tons of old lead-smelter slag smelted and fumed.

Mine production of metals from Idaho crude ore shipped to smelters in 1946, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Adams	23	4	172	13,500		
Blaine	472	44	3,187	1,035	30,819	53,412
Boise	163	125	1,691		200	
Bonner	5		2,474	200		
Butte	92	5	1,599	757	680	
Camas	9	31	16			
Clark	52		47		19,800	
Custer	8,455	149	54,093	71,000	608,760	1,729,105
Elmore	82	588	3,093			
Gem	50	30	1,278			
Idaho	42	17	16			
Lemhi	1,084	88	8,669	6,000	335,550	31,400
Owyhee	4	11	151			
Shoshone	[1] 98,126	26	48,468	1,565	4,008,308	17,804,200
Valley	3	4	263		200	
Washington	5		26		4,000	
Total: 1946	[1] 108,667	1,122	125,243	94,057	5,008,317	19,618,117
1945	[2] 109,856	1,502	141,420	434,277	5,112,272	18,147,421

BY CLASSES OF ORE

Dry and siliceous gold	454	801	3,410	361	288	
Dry and siliceous gold-silver	126	110	3,990		400	
Dry and siliceous silver	250	8	6,148	1,305	10,260	
Copper	903	60	1,086	53,275		
Lead	7,493	61	36,667	6,245	1,308,818	3,900
Lead-copper	119	1	18,154	9,345	36,850	
Zinc	[1] 97,677	28	33,627	14,280	3,310,300	19,375,000
Zinc-lead	1,645	53	22,161	9,246	341,401	239,217
Total 1946	[1] 108,667	1,122	125,243	94,057	5,008,317	19,618,117

[1] Includes 92,072 tons of old lead-smelter slag smelted and fumed.
[2] Includes 92,266 tons of old lead-smelter slag smelted and fumed.

REVIEW BY COUNTIES AND DISTRICTS

ADAMS COUNTY

In 1946 the output in Adams County was all carbonate copper ore (23 tons) produced from the Helena claim near Cuprum in the Seven Devils district.

BENEWAH COUNTY

John Bush operated his placer claim on the South Fork of Tyson Creek a short time in 1946 and recovered 14 fine ounces of gold from sluicing 250 cubic yards of gravel.

BLAINE COUNTY

Lava Creek District.—In April 1946 Smith Bros. began mining zinc-lead-iron ore from the Paymaster mine, 32 miles southwest of Arco, and during the year shipped 3,339 tons of ore to custom milling plants in Utah, where a lead concentrate, a zinc concentrate, and an iron concentrate were recovered.

Little Wood River (Muldoon) District.—Lessees worked the Jupiter-Garfield group in 1946 and shipped 207 tons of zinc-lead-iron ore to custom flotation mills in Utah.

Mineral Hill and Camas District.—A total of 3,261 tons of old tailings, containing 40 ounces of gold, 23,232 ounces of silver, 8,170 pounds of copper, 88,385 pounds of lead, 304,789 pounds of zinc, and some iron, was shipped from the Red Elephant dump near Hailey to the custom milling plant at Midvale, Utah, from June to September 1946.

Warm Springs District.—Despite an increase in the prices of silver, lead, and zinc in 1946, the output of zinc-lead-silver ore from the Triumph-North Star-Independence groups declined from 93,067 tons in 1945 to 69,836 tons in 1946. The Triumph Mining Co. operated the groups throughout 1946 and in its 300-ton gravity-flotation mill, treated 56,799 tons of ore, containing 5,696 ounces of gold, 449,798 ounces of silver, 227,196 pounds of copper, 3,067,813 pounds of lead, and 4,380,544 pounds of zinc, which yielded 15,036 tons of zinc-lead middlings and 2,474 tons of lead-silver concentrate. The middling and 13,037 tons of zinc-lead-silver ore were shipped to Bauer, Utah, for treatment, and the lead-silver concentrate was shipped direct to a lead smelter. The property remained the most important producer of gold, silver, lead, and zinc in southern Idaho.

BOISE COUNTY

Boise Basin District (Centerville, Placerville, Idaho City, Pioneerville, Quartzburg).—The output of gold in the Boise Basin district, in 1946 was 7,758 ounces compared with 1,858 ounces in 1945. This marked increase resulted mainly from the operation of two bucket dredges—a 6-cubic foot and a 2-cubic foot—by Baumhoff & Marshall (formerly Fisher-Baumhoff Co.) that had been idle since October

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1946, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Adams County: Seven Devils	1		23	4		4	172		172	13,500			$2,466
Benewah County: Tyson Creek		1			14	14							490
Blaine County:													
Lava Creek [1]	1		3,339	22		22	6,073		6,073	4,500	122,000	351,000	62,526
Little Wood River (Muldoon)	1		207				1,432		1,432	500	26,000	18,000	6,268
Mineral Hill and Camas	4		3,506	35		35	21,703		21,703	6,000	91,000	242,000	59,176
Warm Springs	5		70,954	3,617		3,617	418,599		418,599	206,500	3,298,000	4,322,000	1,385,042
Boise County:													
Boise Basin	8	14	318	152	7,606	7,758	1,708	1,750	3,458		200		274,346
Shaw Mountain	1		2	5		5							175
Summit Flat	2		49	46		46	26		26				1,631
Bonner County: Clark Fork	1		880				6,661		6,661	300	46,000	3,000	10,811
Lakeview	1		2,000	8		8	11,000		11,000	1,000	25,000	15,000	13,885
Pend d'Oreille	1		5				2,474		2,474	200			2,031
Bonneville County: Mount Pisgah		1			47	47							1,645
Boundary County: Port Hill	1		3,845	1		1	1,646		1,646	1,500	87,000	8,000	12,067
Butte County:													
Dome	2		3,881	8		8	3,182		3,182	3,500	447,000	40,000	57,021
Lava Creek [1]	1		862	11		11	2,797		2,797	1,500	38,000	93,000	18,376
Camas County:													
Little Smoky		1			1	1							35
Skeleton Creek	1		9	31		31	16		16				1,098
Clark County: Birch Creek	1		52				47		47		19,800		2,196
Clearwater County: Pierce		1			121	121		42	42				4,269
Custer County:													
Alder Creek	3		6,897	86		86	12,182		12,182	53,500	271,000	1,575,000	243,209
Bayhorse	7		13,400	35		35	84,052		84,052	24,500	1,105,000	375,000	239,303
Boulder	1		500	4		4	3,687		3,687	1,000	146,000	67,000	27,369
Seafoam	4		309	11		11	6,292		6,292	1,000	67,000	36,000	17,326
Yankee Fork	4	1	31	40	5,232	5,272	464	2,771	3,235				187,134
Elmore County:													
Boise River		1			2	2							70
Middle Boise	3	2	14,605	5,659	4,035	9,694	27,161	1,401	28,562				362,368
Snake River		1			4	4							140
Gem County: West View	3	2	61	34	20	54	1,344	10	1,354		600	1,600	3,244
Idaho County:													
Burgdorf-Marshall Lake	1	2	4	1	71	72		16	16				2,533
Camp Howard		2			8	8							280
Dewey-Harpster	1		42	17		17	16		16				608
Dixie	1	1	20	9	7	16	5		5				564
Elk City		3			675	675		125	125				23,726

See footnote at end of table.

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1946, by counties and districts, in terms of recovered metals—Con.

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Idaho County—Continued													
Florence and French Creek		4			6	6							$210
Orogrande		2			627	627		141	141				22,059
Simpson		4			42	42		5	5				1,474
Ten Mile	1	1	70	21	7	28	5		5				984
Warren	2	3	12	4	12	16		5	5				564
Jerome County: Snake River		3			29	29							1,015
Lemhi County:													
Blue Wing	1		30,605	13		13	48,667		48,667	78,000	75,000		60,589
Eureka	4		78	19		19	401		401		3,000		1,316
Gibbonsville	1	3	9	8	1,330	1,338	5	115	120				46,927
Kirtley Creek		1			142	142		21	21				4,987
Mackinaw		4			39	39		5	5				1,369
McDevitt	1		3	5		5	21		21	1,500			435
Rattlesnake Creek	1		200	1		1	698		698	1,000	27,000		3,704
Texas	2		977	58		58	7,823		7,823	4,000	319,400	31,400	47,645
Unorganized (Reno)	1		49				109		109	500	14,000		1,695
Yellow Jacket	1		8	1		1	318		318		2,000		510
Nez Perce County: Snake River		1			8	8							280
Owyhee County:													
Carson or French	4	2	876	35	2	37	172	10	182				1,442
Snake River		2			8	8							280
Power County: Snake River		1			1	1							35
Shoshone County:													
Beaver	3		80,123	82		82	90,281		90,281	68,500	4,224,000	8,748,000	1,614,586
Coeur d'Alene	1	1	2,600	1	2	3	2,323		2,323	500	85,000	65,000	19,258
Eagle	1		2,885	16		16	6,510		6,510	3,500	450,000	50,000	61,537
Evolution	10		931,350	215		215	3,098,557		3,098,557	900,500	13,580,000	16,335,000	6,130,130
Hunter	6		342,633	225		225	505,000		505,000	133,500	23,345,000	32,698,000	6,971,303
Lelande	9		160,902	115		115	227,339		227,339	73,500	8,204,000	8,271,000	2,102,920
Placer Center	8		132,116	132		132	188,948		188,948	50,500	8,368,000	8,321,000	2,092,745
Summit	2		710	27		27	339		339	1,000	69,000	33,000	12,928
Yreka	16		906,317	943		943	1,536,375		1,536,375	387,500	54,771,000	60,337,000	14,668,324
Twin Falls County: Snake River		3			13	13							455
Valley County:													
Deadwood Basin	1	1	16,350	253	1	254	79,932		79,932	53,000	643,800	978,000	271,551
South Fork of Salmon River		2			11	11		5	5				389
Yellow Pine	2		147,508	10,842		10,842	78,094		78,094		200		442,592
Washington County: Heath	1		5				26		26		4,000		457
Total Idaho	139	71	2,882,187	22,852	20,123	42,975	6,484,682	6,422	6,491,104	2,076,000	119,974,000	143,014,000	37,610,123

[1] Lava Creek district is in both Blaine and Butte Counties.

1942, when War Production Board Order L–208 closed all gold mines. The two dredges operated on Granite and Ophir Creeks near Centerville and treated a total of 1,155,000 cubic yards of gravel, which yielded 4,943 fine ounces of gold and 1,111 fine ounces of silver. The Idaho-Canadian Dredging Co. worked its 7½-cubic foot bucket dredge at property on Moores Creek near Idaho City from March 1 to October 9; 805,000 cubic yards of gravel were washed, which yielded 2,602 fine ounces of gold and 627 fine ounces of silver.

The lode output of the district was 152 ounces of gold, 1,708 ounces of silver, and 200 pounds of lead, recovered largely from ore produced from the Come-Back mine and from old tailings from the Boulder dump.

BONNER COUNTY

Clark Fork District.—The Whitedelf mine of the Whitedelf Mining & Development Co. was operated on a production basis only during the first quarter of the year; thereafter all work was confined to development. About 880 tons of silver-lead ore were treated in the company 50-ton flotation mill, which yielded 67 tons of high-grade silver-lead concentrate.

Lakeview District.—Operations at the Hewer (Idaho-Lakeview) mine were continuous throughout the year; and 2,000 tons of silver ore, containing a little copper, lead, and zinc, were treated by flotation.

Pend d'Oreille District.—Five tons of ore, containing 2,474 ounces of silver and 302 pounds of copper, were produced from the Brown Bear claim in 1946 and shipped direct to a lead smelter.

BONNEVILLE COUNTY

Oscar Lundin worked the Lottie placer near Gray in the Mount Pisgah district during the spring months of 1946 and recovered 47 fine ounces of gold from bench gravel by hydraulicking and sluicing.

BOUNDARY COUNTY

All the output in Boundary County in 1946 was old tailings (3,845 tons), containing 2 ounces of gold, 2,500 ounces of silver, 3,000 pounds of copper, 131,500 pounds of lead, and 16,000 pounds of zinc, from the Idaho-Continental dump in the Port Hill district.

BUTTE COUNTY

Dome District.—William H. Gibson worked the Wilbert mine continuously in 1946 and shipped 1,750 tons of zinc-lead ore to the custom flotation mill at Bauer, Utah. Old tailings (2,131 tons), containing chiefly silver and lead, from the Wilbert dump were treated in a 50-ton gravity concentrator on the property by M. C. Settles.

Lava Creek District.—The metal output of the Lava Creek district in Butte County in 1946 was much less than that in 1945, as the Era Mining & Development Co. ceased shipping zinc-lead-iron ore from the Horn Silver mine in March 1946. During the first quarter of the year the company shipped 770 tons of zinc-lead-iron ore to custom flotation mills in Utah and in August shipped 92 tons of silver ore direct to a smelter.

CLEARWATER COUNTY

Hellerud & Lewis leased the Crawford placer claims on Cow Creek in the Pierce district in 1946, and during the last 2 months of the year recovered 121 fine ounces of gold and 42 fine ounces of silver from washing 75,000 cubic yards of gravel in a dry-land plant.

CUSTER COUNTY

Alder Creek District.—The most important output in the Alder Creek district in 1946 was oxide zinc ore produced from the Homestake mine near Mackay by the White Knob Mining Co.; 5,605 tons of ore were shipped to a lead smelter where the gold, silver, and lead were recovered; the hot slag was fumed for recovery of zinc. In addition, 171 tons of silver-lead ore were shipped direct to a lead smelter. The rest of the district output was 877 tons of copper ore produced from the Empire mine and 244 tons of lead ore from the Horseshoe mine.

Bayhorse District.—Operations at the Clayton mine, the principal producer in the Bayhorse district, were interrupted from February 1 through June 1946 by labor strikes; however, mining of zinc-lead ore was not resumed until after August. During the year 10,764 tons of zinc-lead ore were produced from this mine and treated in the company 120-ton flotation mill compared with 29,127 tons in 1945. Swigert Mines operated the Pacific claim of the Salmon group nearly all year, treated 1,200 tons of zinc-lead ore by gravity concentration, and shipped 1,136 tons of similar ore to a lead smelter in Utah. The remainder of the district output comprised 132 tons of silver-lead ore from the South Butte mine, 119 tons of high-grade lead-copper-silver ore from the Ramshorn mine, 37 tons of lead ore from the Twin Apex and Turtle properties, and 12 tons of zinc-lead ore from the St. Joe claim.

Boulder District.—Owners of the Livingston mine shipped 500 tons of zinc-lead ore to custom flotation mills in Utah by May 10, 1946, when the mine was sold to C. A. Tout, of Victor, Mont.

Yankee Fork District.—The output of the Yankee Fork district in 1946 was 5,272 ounces of gold and 3,235 ounces of silver compared with 125 ounces of gold, 76 ounces of silver, and 200 pounds of copper in 1945. This notable gain in output of gold and silver resulted from resumption in April 1946 of bucket dredging at the Yankee Fork placer by the Snake River Mining Co. after being idle since October 1942. The 8-cubic-foot bucket dredge operated until December 20, 1946, and treated 1,098,853 cubic yards of gravel.

ELMORE COUNTY

Middle Boise (Atlanta) District.—Greater activity at both lode and placer properties in the Middle Boise district in 1946 resulted in an increase of $332,220 in the value of the metal output over 1945. The principal producers were the Boise-Rochester-Monarch lode property of Talache Mines, Inc., and the Boise King placer property of Pyramid Mining Co. (formerly Boise King Placers). Talache Mines, Inc., operated its mine and 400-ton amalgamation and concentration mill continuously; the mill treated 14,523 tons of gold ore, which yielded

5,071 fine ounces of gold and 24,068 fine ounces of silver. In addition, 68 tons of high-grade gold ore were shipped direct to a smelter. The Pyramid Mining Co. worked its 7½-cubic-foot bucket dredge from April 30 to September 30, and treated 557,394 cubic yards of gravel.

IDAHO COUNTY

Gold mining in Idaho County was greater in 1946 than in any year since the war but is still far below that during the years before the war. Two dredges that were large producers of gold in 1942 and had to close because of War Production Board Order L–208 began operating again in the spring of 1946. Bangasser & Smith, Inc. (formerly Mt. Vernon Co.), operated its 2-cubic-foot bucket dredge from March 1 to September 7 at the Crooked River property in the Orogrande district. This dredge treated 126,499 cubic yards of gravel and recovered 625 fine ounces of gold and 141 fine ounces of silver. The Tyee Mining Co. operated its dragline dredge with floating washing plant from June 25 to November 1 at property on American River in the Elk City district. The Secesh Dredging Co. (a new operator) placed a 2½-cubic foot bucket dredge at property on Secesh Meadows in the Burgdorf-Marshall Lake district, but it operated only 1 month.

LEMHI COUNTY

Blue Wing District.—Silver-tungsten ore from the Ima mine was mined and milled continuously by the Bradley Mining Co. throughout the year. The company reported that 30,605 tons of ore containing hübnerite, galena, tetrahedrite, and pyrite were treated in a 150-ton concentrator; 168 tons of tungsten concentrate were recovered by gravity and flotation concentration, followed by magnetic separation; and 923 tons of lead-copper-silver concentrate were recovered by bulk sulfide flotation.

Gibbonsville District.—The dragline dredge with a floating washing plant at the Hagel placer property—a large producer of gold in 1942 which had to close on account of War Production Board Order L–208—resumed operation in May 1946. Smith Bros. & Courtis, Inc., operated the dredge, which handled about 160,000 cubic yards of gravel during the last 8 months of the year.

Kirtley Creek District.—In September 1946 a dragline dredge and dry-land washing plant were placed on the Hagel Ranch ground on Kirtley Creek by the Washington Iron Works; the dredge operated from October 10 to November 10 and handled 22,000 cubic yards of gravel.

Texas District.—Milo Zook operated the Latest Out mine at Gilmore nearly all year and shipped 751 tons of oxide zinc-lead-silver ore to smelters in Utah. The rest of the district output was 226 tons of lead ore produced from the Alex Stevens mine.

OWYHEE COUNTY

The principal output in Owyhee County in 1946 was 872 tons of surface gold ore, treated by amalgamation and concentration, from the Lewis group in the Carson district, and placer gold recovered from gravel along the Snake River near Grandview.

SHOSHONE COUNTY—COEUR D'ALENE REGION

Despite higher prices for silver, copper, lead, and zinc in 1946, production of these metals in the Coeur d'Alene region, Shoshone County, was far below that in 1945; a shortage of labor was the principal factor that interfered with normal production. The output of silver declined more than 20 percent, copper 20 percent, lead 11 percent, and zinc more than 13 percent; production of gold declined only 7 percent. The value of the metal output of the region was $33,673,731 (more than 89 percent of the State value) compared with $34,258,050 in 1945. Although production of silver, lead, and zinc decreased substantially in 1946, the region remained the largest silver-producing area in the United States and ranked second in lead and zinc; it produced 87 percent of Idaho's silver, 78 percent of the copper and 94 percent each of the lead and zinc. The chief producers of zinc in the region in 1946, according to rank (each producing more than 6,000,000 pounds), were the Star, Bunker Hill smelter-slag dump, Osburn tailing plant, Page, Morning, and Tamarack properties. The chief producers of lead, according to rank (each producing more than 6,800,000 pounds), were the Bunker Hill & Sullivan, Page, Star, Osburn tailing plant, Morning, and Sweeny tailing properties. The chief producers of silver, according to rank (each producing more than 375,000 ounces), were the Sunshine, Polaris, Bunker Hill & Sullivan, Silver Dollar, Osburn tailing plant, and Page properties.

Of the total material (2,559,636 tons) produced in 1946 in the Coeur d'Alene region, 90 percent was zinc-lead ore and old tailings, 4 percent silver-lead ore, 3 percent zinc slag, and nearly all the remainder silver ore.

Mine production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region, Shoshone County, 1945–46, and total 1884–1946, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (Lode and placer) (fine ounces)	Silver (Lode and placer) (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer							
1945	49	1	2,794,208	1,898	7,115,646	2,036,000	126,860,000	156,059,000	$34,258,050
1946	56	1	2,559,636	1,758	5,655,672	1,619,000	113,096,000	134,858,000	33,673,731
Total, 1884–1946	------	-------	[1]	393,066	432,287,424	[2] 65,364	[2] 5,532,067	[2] 1,196,866	1,122,925,382

[1] Figure not available.
[2] Short tons.

Beaver District.—The output of the Beaver district in 1946 was 80,123 tons of zinc-lead ore, a drop of 32,484 tons from that in 1945. This loss resulted largely from a decline in output of zinc-lead ore from the Amazon-Carlisle-Portland group (Monitor Mining Co.) caused by a shortage of underground miners. The company reported that 48,608 tons of ore, averaging 0.97 ounce of silver to the ton, 2.21 percent lead, and 6.16 percent zinc, were treated in the Hercules, Dayrock, and Carlisle flotation mills near Wallace. According to the printed annual report of the Monitor Mining Co. for 1946, development and exploration were greater than in 1945; but not as much new

ore was discovered as was extracted, owing to a large amount of work required to rehabilitate and connect the old Interstate mine with the Amazon and Carlisle workings. Underground labor turn-over during the past year was roughly 400 percent, and at the end of the year the company had 145 employees. Known ore reserves remain substantial, though relatively low in grade.

Sunset Lease worked the Sunset mine continuously and hauled 27,656 tons of ore, averaging 2.35 ounces of silver to the ton, 4.52 percent lead, and 7.14 percent zinc, to the Golconda custom flotation mill near Wallace. The rest of the district output was 3,859 tons of zinc-lead ore produced from the Nipsic claim of the Interstate-Callahan group by the Daylight Lease. This lease was abandoned in March, as all commercial ore was exhausted.

Evolution District.—The output of the Evolution district in 1946 comprised 869,954 tons of zinc-lead old tailings, 51,111 tons of silver-lead ore, 8,193 tons of silver-copper-antimony ore, 2,000 tons of zinc old tailings, 50 tons of silver ore, and 42 tons of old mill cleanings (lead-silver). Most of the old tailings came from the Osburn dump, all the silver-lead ore from the Chester vein and the Silver Syndicate fault zone, and all the silver-copper-antimony ore from the Mineral Point mine. The 2,500-ton sink-and-float plant and 500-ton flotation mill at the Osburn tailing dump were operated throughout the year by the Hecla Mining Co. The company reported that 845,468 tons of old tailings, containing an average of 1.19 ounces of silver to the ton, 1.33 percent lead, 1.43 percent zinc, and a little copper, were treated during the year in the sink-and-float plant; the resulting zinc-lead middling (530,579 tons) was treated in the Osburn, Polaris, and Hecla flotation mills, where it was separated into 7,220 tons of lead concentrate and 15,703 tons of zinc concentrate. The property ranked third in zinc production in Idaho in 1946, fourth in lead, and fifth in silver. Zanetti Bros. worked another part of the Osburn tailing dump during the last quarter of the year and hauled 15,986 tons of zinc-lead old tailings to the Polaris mill for treatment. The Sunshine Mining Co. operated the Chester vein and the Silver Syndicate fault zone continuously, and developed the Yankee Girl vein in Sunshine Consolidated ground during the year after a 3-year suspension. The Chester vein and Silver Syndicate fault zone (known as Rambo, Omega, and Rotbart areas) includes property owned by the Sunshine Mining Co., Polaris Mining Co., Silver Dollar Mining Co., and Silver Syndicate, Inc., but all exploration, development, mining, and milling of ore are done by the Sunshine Mining Co. The Sunshine Mining Co. reported that the total output of ore in 1946 was 51,044 tons (21,251 tons for Sunshine account and 29,793 tons for account of Polaris, Silver Dollar, and Silver Syndicate) compared with 75,179 tons in 1945; the ore averaged 49.13 ounces of silver to the ton, 0.61 percent copper, 4 percent lead, and a little zinc. The tailings averaged 0.86 ounce of silver to the ton and 0.13 percent lead; lead recovery was 97.2 percent and silver 98.5 percent. Lead-silver concentrates (6,760 tons) contained 2,469,252 ounces of silver, 607,240 pounds of copper, and 3,948,371 pounds of lead, of which the net for Sunshine account was 959,472 ounces of silver, 237,284 pounds of copper, and 1,551,304 pounds of lead. Production credited to the other companies (Polaris, Silver Dollar, and Silver Syndicate) was 1,509,780 ounces

of silver, 369,956 pounds of copper, and 2,397,067 pounds of lead. The average per-ton operating costs for the year were $10.62 for mining, $1.34 for ore treatment, $0.54 for depreciation, and $7.51 for general expense and overhead—a total of $20.01. According to the annual report of the Sunshine Mining Co., production was less in 1946 than in 1945 owing to the after effects of a mine fire in December 1945 and to a serious labor shortage during the summer months of 1946. Developments of especial interest during the year were extensions of drifts at the 3,700-foot level on the Silver Syndicate fault and at the 3,100-foot level (Sunshine Consolidated) on the Yankee Girl vein. The former drift was advanced about 100 feet beyond that reported in 1945, and of the 265 feet now exposed 210 feet show ore averaging 4.3 feet in width having an average assay of 46.0 ounces of silver per ton and 21.7 percent lead. The 3,100-foot level of the Sunshine Consolidated drift was advanced 226 feet west on a vein averaging 1.9 feet in width and 54.3 ounces of silver per ton. Total developed ore reserves increased over those of 1945 and were estimated at 1,230,000 tons.

The Coeur d'Alene Mines Corp. operated its Mineral Point mine throughout the year, but the company 600-ton flotation mill ran only intermittently. The mill treated 8,193 tons of silver-copper-antimony ore, which yielded 179 tons of concentrate containing 72,996 ounces of silver, 94,966 pounds of copper, and 54,855 pounds of antimony. According to the corporation annual report to stockholders, production during part of 1946 was almost completely discontinued, and operations were limited to development and maintenance. The grade of ore mined was too low for profitable operations, but it carried sufficient values to pay a portion of the maintenance and overhead expenses, in addition to the ore-breaking cost. Development during the year failed to disclose adequate quantities of commercial ore. Shaft sinking was begun in May, and in September the shaft was completed to a point 130 feet below the 2,800-foot level. The remainder of the district output was nearly all old tailings (10,500 tons), containing chiefly lead and zinc, from dumps near Osburn and treated in the Galena (Zanetti) custom mill.

Hunter District (Mullan).—The output of ore and old tailings in the Hunter district declined from 450,343 tons in 1945 to 342,633 tons in 1946, owing chiefly to an insufficient supply of underground labor. The principal output was 277,408 tons of zinc-lead ore from the Morning and Star mines, a drop of 118,430 tons from that in 1945. The Morning mine of the Federal Mining & Smelting Co. was operated continuously; 88,552 tons of waste-dump ore, containing an average of 1.1 ounces of silver to the ton, 1.7 percent lead, and 1.6 percent zinc, and 56,945 tons of mine ore, containing an average of 2 ounces of silver to the ton, 6.4 percent lead, and 6.7 percent zinc, were treated in the company 1,250-ton flotation mill at Mullan. The average mill recoveries in lead concentrate were silver 76 percent, lead 85 percent, and zinc 14.5 percent; in zinc concentrate, silver 13.6 percent, lead 4.3 percent, and zinc 76.2 percent. According to the annual stockholders' report of the company for 1946, production was less than that in 1945 because of a labor shortage, which continued throughout the year, but some improvement was noted during the last 3 months, and the year closed with a gain of 34 men; however,

on January 1, 1947, the crew was about 200 men below normal. No shaft sinking was done in 1946, and development was limited. Ore reserves at the end of the year, including developed and probable ore in both the Morning and You-Like portions of the mine, are estimated at 545,000 tons, a decrease of 37,500 tons from the estimated tonnage at the end of 1945.

The 1,000-ton flotation mill of the Sullivan Mining Co. at the Star mine operated continuously in 1946, but at a lower rate than in 1945. The mill treated 131,911 tons of zinc-lead ore (145,527 tons in 1945) from the Star mine, yielding 7,046 tons of lead concentrate and 23,743 tons of zinc concentrate, which contained 143 ounces of gold, 174,354 ounces of silver, 12,073,679 pounds of lead, and 25,476,553 pounds of zinc. The mine continued as the largest producer of zinc in Idaho and ranked third in lead. The Hunter Lease has operated the Gold Hunter mine at Mullan since July 3, 1933, and in 1946 the 500-ton flotation mill on the property treated 37,430 tons of mine ore and 9,750 tons of waste-dump ore, which contained 98,560 ounces of silver, 90,000 pounds of copper, 2,050,440 pounds of lead, and 353,000 pounds of zinc. The remainder of the district output comprised 14,670 tons of old zinc-lead tailings from the Granada and Mary D. properties and 3,375 tons of zinc-lead-silver ore from the Lucky Friday mine; all old tailings and ore were treated in the Golconda custom flotation mill near Wallace.

Lelande District (Burke, Mace, Firsco).—A total of 160,902 tons of ore and old tailings was treated from nine properties in the Lelande district in 1946 compared with 155,802 tons of ore and old tailings from nine properties in 1945. The output in 1946 was largely 80,000 tons of old zinc-lead tailings from the Canyon Creek and Elgin properties above Wallace and 65,862 tons of zinc-lead-silver ore from the Frisco and Sherman mines. Approximately 80,000 tons of old tailings, containing an average of 1 ounce of silver to the ton, 1.4 percent lead, and 2.1 percent zinc, from the Canyon Creek and Elgin properties, were treated in 1946 in the Formosa 140-ton flotation mill of the Small Leasing Co. and in the Golconda custom flotation mill. The Federal Mining & Smelting Co. worked the lower levels of the Frisco mine at Gem throughout the year and hauled 28,828 tons of ore (containing an average of 1.27 ounces of silver to the ton, 3.50 percent lead, and 5.97 percent zinc) to the Morning mill at Mullan; Hull Lease continued working the upper levels and, in its own 90-ton flotation mill at Gem, treated 18,159 tons of similar ore, which yielded 856 tons of lead concentrate and 1,896 tons of zinc concentrate. According to the annual stockholders' report of the Federal Mining & Smelting Co., operations at the Frisco mine were retarded in 1946 by a labor shortage. With more labor, production will gradually expand, and a further increase will result when a new hoist is put in operation about the middle of 1947. Ore reserves at the end of 1946 were estimated at 210,000 tons of developed and probable ore. From present indications, additional ores will be developed as the lower levels are made accessible.

The Sherman Lead Co. operated its mine and 300-ton flotation mill continuously in 1946, but at a lower rate than in 1945. In 1946 the mill treated 18,875 tons of ore, containing an average of 5.57 ounces of

silver to the ton, 9.51 percent lead, and 1.98 percent zinc, which yielded 3,022 tons of zinc-lead-silver concentrate. According to the company annual report to stockholders, very little development work was done at the Sherman mine in 1946, and output of ore was less than in 1945, due entirely to lack of underground labor. The average crew of men decreased from 60 to 53, leaving the company lacking more than 50 men required for capacity production. The rest of the district output comprised 8,022 tons of silver-lead ore produced from the Hercules mine, 2,157 tons of lead ore from the Black Bear mine, 884 tons of zinc-lead ore from the Mace property, 477 tons of silver-lead ore from the Hecla mine, and 3,500 tons of old zinc-lead tailings from the Woodland property.

Placer Center District.—The output of the Placer Center district in 1946 was 99,438 tons of zinc-lead-silver ore and old tailings, 27,873 tons of silver-lead ore, and 4,805 tons of zinc ore and old tailings. More than 77 percent of the zinc-lead-silver ore and old tailings came from the Tamarack mine, and all of the silver-lead ore came from the Dayrock property. The Tamarack & Custer Consolidated Mining Co. reported that 66,324 tons of ore (containing an average of 1.1 ounces of silver to the ton, 3.4 percent lead, and 5.2 percent zinc) were produced from the Tamarack mine in 1946 (66,082 tons in 1945) and treated in its 400-ton flotation mill. In addition, lessees hauled 1,976 tons of mine ore and 8,707 tons of waste-dump ore to custom flotation mills near Wallace. According to the company annual report to stockholders, the tons of ore milled in 1946 were about the same as that in 1945, but production of lead and zinc was less, owing to a lower metal content. Development was much more extensive than in 1945, especially on the 2,200- and 2,400-foot levels. The most important disclosure was on the 2,400-foot level—deepest in the mine—of a sill 600 feet long and containing good-grade ore. However, it appears that the future of the mine depends on deeper exploration, which will require larger hoisting facilities. Ore reserves were increased slightly during the year. The company is still short 200 men required for capacity production.

The 200-ton flotation mill of the Dayrock Mining Co. ran continuously in 1946; it treated 27,873 tons of ore (containing an average of 3.5 ounces of silver to the ton, 5.7 percent lead, and 0.9 percent zinc) from the Dayrock property and 6,259 tons of custom ores. According to the annual stockholders' report of the Dayrock Mining Co., work at the Dayrock mine in 1946 was carried on at all levels below the 100-foot level, resulting in a substantial increase in ore reserves; current known ore is greater in tonnage than in several past years.

The Callahan Consolidated Mines, Inc., operated its Rex group until June 30, 1946, when operations ceased. During the 6-month operation the company 100-ton flotation mill treated 15,768 tons of Rex ore containing 9,450 ounces of silver, 600,000 pounds of lead, and 1,200,000 pounds of zinc. The remainder of the district output was 6,663 tons of zinc-lead old tailings from the Rose and Zanetti properties, 3,500 tons of zinc old tailings from the Tomsche property, and 1,305 tons of zinc ore from the Success mine—all treated in custom flotation mills near Wallace.

Yreka District (Kellogg).—The value of the metal output of the Yreka district was $14,668,324 in 1946, an increase of $2,091,994 over 1945. The district remained the chief lead- and zinc-producing area in Idaho and ranked second in silver. In 1946 material treated in the district comprised 754,039 tons of zinc-lead-silver ore and old tailings, 92,072 tons of old zinc slag, 44,205 tons of old zinc-lead-iron-silver tailings, and 16,001 tons of silver-lead ore—a total of 906,317 tons compared with a total of 852,433 tons in 1945. Of the total ore, old tailings, and old slag, 275,435 tons were zinc-lead-silver ore from 10 mines in the Pine Creek area of the district; however, the Bunker Hill & Sullivan mine at Kellogg, with an output of 160,371 tons of zinc-lead-silver ore and 11,012 tons of silver-lead ore in 1946, continued to be the most important producer of ore in the district. The company main 1,700-ton flotation mill, equipped with a sink-and-float unit, operated throughout the year and treated 160,371 tons of zinc-lead-silver ore from the Bunker Hill & Sullivan mine and 317,733 tons of old zinc-lead tailings from the Sweeny dump. The ore contained an average of 4.53 ounces of silver to the ton, 6.37 percent lead, and 2.14 percent zinc and the old tailings 0.81 ounce of silver to the ton, 1.58 percent lead, and 0.74 percent zinc. In addition, 1,012 tons of silver-lead ore were produced from the Bunker Hill & Sullivan mine and shipped direct to a smelter. John George continued leasing operations in the upper levels of the Bunker Hill & Sullivan mine and treated about 10,000 tons of silver-lead ore in his mill. The Bunker Hill & Sullivan Mining & Concentrating Co. also operated its 300-ton gravity-flotation plant from April to the end of the year; treated 44,205 tons of old jig tailings containing an average of 1.35 ounces of silver to the ton, 2.48 percent lead, 1.07 percent zinc, and 16.32 percent iron; and shipped 92,072 tons of old Bunker Hill smelter slag (containing an average of 0.30 ounce of silver to the ton, 1.85 percent lead, and 12.08 percent zinc) to its lead smelter at Bradley. The resulting hot slag was sent to the slag-fuming plant, also at Bradley, to recover the zinc. According to the company annual report to stockholders, there were produced and recovered from Bunker Hill & Sullivan mine ore (including lessee ore) 673,330 ounces of silver, 19,678,000 pounds of lead, and 5,808,000 pounds of zinc. A decrease in metal output in 1946, as well as in 1945, resulted entirely from a shortage of labor; however, some improvement in the manpower shortage was noticeable during the last weeks of the year. Development in 1946, as in former years, was held to a minimum because of the shortage of underground labor and consisted largely of extending known ore bodies. This resulted in a slight decrease of ore reserves fully developed and ready for mining—ore reserves January 1, 1947, totaled 2,586,461 tons of zinc-lead-silver ore. Operations at the zinc slag-fuming plant of the Bunker Hill & Sullivan Mining & Concentrating Co. at Bradley were continuous throughout the year. In 1946 the plant received 140,044 tons of current hot slag from the lead furnaces of the Bunker Hill smelter at Bradley; the resulting lead fume (3,936 tons) was sent to the Bunker Hill lead smelter, and the zinc fume (22,579 tons) was shipped to smelters in the East. All of the lead and zinc produced at the plant in 1946 was

credited to the mines and an old slag dump furnishing the slag-making material.

Output of zinc-lead-silver ore from the Page mine of the Federal Mining & Smelting Co. increased from 80,727 tons in 1945 to 102,875 tons in 1946. The ore, treated in the Page 500-ton flotation mill, contained an average of 3.97 ounces of silver to the ton, 7.01 percent lead, and 7.92 percent zinc. The mine ranked second in lead production in Idaho in 1946, fourth in zinc, and seventh in silver. According to the annual stockholders' report of the company, no shaft sinking or development was done in 1946 because of insufficient labor; however, the labor supply improved during the last 3 months of the year, and the crew gained 48 men for the year. On January 1, 1947, the crew was only 20 men below normal. Ore reserves at the end of the year were estimated at 618,000 tons of developed and probable ore—a decrease of 59,000 tons from the estimated tonnage at the end of 1945.

The Denver Development Co. continued to operate under lease the Little Pittsburg mine on Denver Creek; and during the year 39,844 tons of ore, containing an average of 1.01 ounces of silver to the ton, 2.47 percent lead, and 6.35 percent zinc, were treated in the company 150-ton flotation mill. The capacity of the mill at the Spokane-Idaho property on Pine Creek was increased to 175 tons of ore a day during 1946, and the company reported that 36,715 tons of ore containing 75,000 ounces of silver, 2,350,000 pounds of lead, and 6,000,000 pounds of zinc were treated by flotation. Operations at the Highland-Surprise mine on Stewart Creek by the Highland-Surprise Consolidated Mining Co. were continuous in 1946; the company 200-ton flotation mill treated 25,940 tons of ore containing 23,000 ounces of silver, 1,571,900 pounds of lead, and 3,055,000 pounds of zinc. Output of zinc-lead-silver ore from the Sidney mine of the Sidney Mining Co. on Denver Creek increased from 17,286 tons in 1945 to 24,562 tons in 1946. In June the company completed a new 250-ton flotation mill which replaced the old 50-ton plant. The Liberal King mine on Pine Creek was operated under lease throughout the year by Sunset Minerals, Inc.; 20,793 tons of zinc-lead ore were treated in the company 100-ton flotation mill. The Small Leasing Co. operated the Douglas mine, also on Pine Creek, continuously in 1946 and treated by flotation 15,112 tons of ore containing 27,000 ounces of silver, 825,000 pounds of lead, and 2,160,000 pounds of zinc. About 8,000 tons of zinc-lead ore were produced in 1946 from the Nabob mine by the Nabob Silver-Lead Co. and treated in the new 250-ton company flotation mill. The rest of the district output was principally 4,989 tons of silver-lead-iron fluxing ore shipped direct to a smelter from the Sierra-Nevada waste dump and 894 tons of zinc-lead ore produced from the Senator Stewart property.

VALLEY COUNTY

Deadwood Basin District.—Mining and milling of zinc-lead-silver ore at the Hall-Interstate property, the only lode producer in the Deadwood Basin district, were on a limited scale in 1946, owing to inadequate ore reserves and a shortage of labor; the output of ore

dropped from 24,377 tons in 1945 to 16,350 tons in 1946. During the first 6 months of the year the property was operated under lease by the Callahan Zinc-Lead Co., and during the last 6 months by a sublessee.

Yellow Pine District.—Milling of gold-silver-iron-antimony ore from the open pit at the Yellow Pine mine by the Bradley Mining Co. was intermittent in 1946; nevertheless, the mine was by far the largest producer of gold in Idaho. During the year the flotation mill treated 147,505 tons of ore (containing an average of 0.10 ounce of gold and 0.58 ounce of silver to the ton and 1.38 percent antimony) and 5,014 tons of old tungsten tailings, which yielded 1,353 tons of gold concentrate, 5,488 tons of gold-antimony concentrate, and 72 tons of tungsten concentrate. When the milling of ore began in May, a complete new flow sheet was introduced, and by adding a rod mill in October the capacity of the mill was increased from 800 to 1,800 tons of ore a day.

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Montana
Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By C. E. NEEDHAM AND PAUL LUFF

	PAGE
General summary	1450
Calculation of value of metal production	1450
Mine production by counties	1455
Mining industry	1456
Mining industry—Continued	
Ore classification	1456
Metallurgic industry	1457
Review by counties and districts	1461
Summit Valley (Butte) district	1471

GENERAL SUMMARY

THE OVER-ALL 58-percent rise in gold production in Montana in 1946 was in sharp contrast to the declines made by the other four metals from 1945 output. Silver in 1946 dropped 45 percent below the yield in 1945; copper, 34; lead, 17; and zinc, 4. Increases in the average prices of all metals except gold had only a slight effect in resisting the 4-year downward trend in total value of the 5 metals, which declined 15 percent from $35,405,505 in 1945 to $29,957,206 in 1946. Of the total value in 1946, copper contributed 63 percent, zinc 14, silver 9, gold 8, and lead 6. Instrumental in maintaining zinc production near the 1945 level were the successful treatment of the Butte Hill waste dumps at Butte (beginning in November) and the treatment of a greater tonnage of old cold smelter slag at the East Helena slag-fuming plant during the labor strike at the East Helena lead smelter. In addition to strikes, labor shortages handicapped the mining industry seriously in 1946.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1942–46

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1942	$35.00	$0.711+	$0.121	$0.067	$0.093
1943	35.00	.711+	.130	.075	.108
1944	35.00	.711+	.135	.080	.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+($20.671835) per fine ounce.

[2] Treasury buying price for newly mined silver. 1942 to June 30, 1946: $0.71111111; July 1, to Dec. 31, 1946: $0.905.

[3] Yearly average weighted price of all grades of primary metal sold by producers; price includes bonus payments by Office of Metals Reserve for overquota production.

Mine production of gold, silver, copper, lead, and zinc in Montana in 1942–46 and total, 1862–1946, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1942	370	170	5,678,280	146,892	$5,141,220	11,188,118	$7,955,995
1943	227	45	5,873,016	59,586	2,085,510	8,450,370	6,009,152
1944	188	24	6,049,462	50,021	1,750,735	7,093,215	5,044,064
1945	160	26	4,919,562	44,597	1,560,895	5,942,070	4,225,472
1946	193	42	2,234,958	70,507	2,467,745	3,273,140	2,644,697
1862–1946			[1]	17,052,121	381,277,447	749,149,823	547,076,052

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1942	282,388,000	$34,168,948	40,100,000	$2,686,700	109,430,000	$10,176,990	$60,129,853
1943	269,050,000	34,976,500	32,648,000	2,448,600	75,212,000	8,122,896	53,642,658
1944	236,380,000	31,911,300	26,210,000	2,096,800	72,254,000	8,236,956	49,039,855
1945	177,012,000	23,896,620	19,998,000	1,719,828	34,806,000	4,002,690	35,405,505
1946	116,962,000	18,947,844	16,560,000	1,805,040	33,540,000	4,091,880	29,957,206
1862–1946	[2] 6,578,353	1,901,800,674	[2] 695,000	77,264,636	[2] 1,862,288	289,422,842	3,196,841,651

[1] Figure not available.

[2] Short tons.

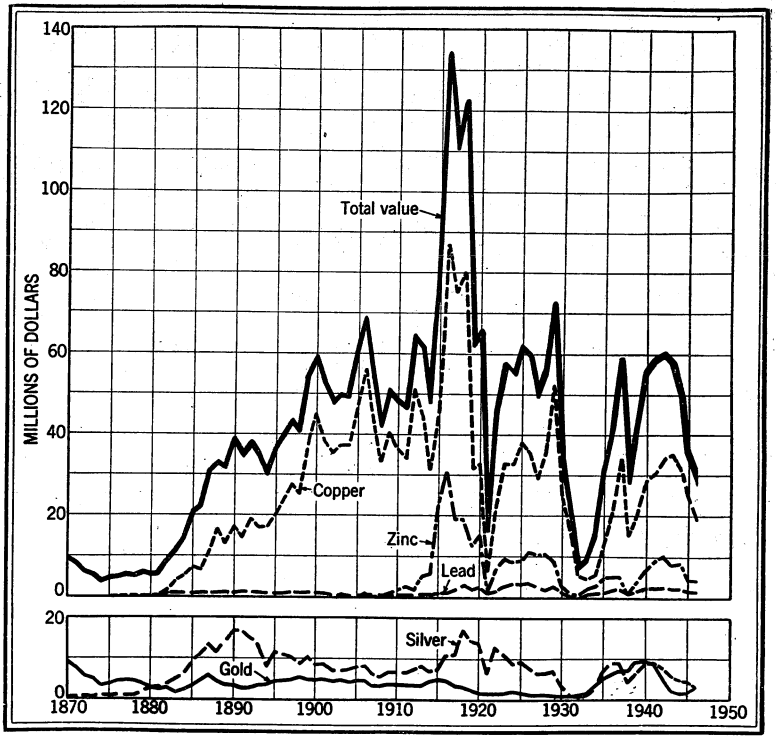

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Montana, 1870–1946.

Gold produced at placer mines in Montana, 1942–46, by classes of mines and by methods of recovery

Class and method	Mines producing	Material treated (cubic yards)	Gold recovered		
			Fine ounces	Value	Average per cubic yard
Surface placers:					
Gravel mechanically handled:					
Connected-bucket dredges:					
1942	7	7,191,603	31,283	$1,094,905	$0.152
1943	3	3,215,759	13,579	475,265	.148
1944	2	1,197,600	5,887	206,045	.172
1945	2	1,497,646	9,181	321,335	.215
1946	4	4,621,073	21,609	756,315	.164
Dragline dredges:					
1942	4	505,454	3,553	124,355	.246
1943					
1944					
1945	2	33,500	359	12,565	.375
1946	4	808,100	4,706	164,710	.204
Becker-Hopkins dredges:					
1946 [1]	1	5,000	32	1,120	.224
Nonfloating washing plants: [2]					
1942	10	409,123	3,674	128,590	.314
1943					
1944					
1945	1	3,000	30	1,050	.350
1946	2	320,000	1,354	47,390	.148
Gravel hydraulically handled:					
Hydraulic:					
1942	2	18,000	102	3,570	.198
1943	1	500	2	70	.140
1944	3	3,750	16	560	.149
1945	2	420	8	280	.667
1946	6	6,950	87	3,045	.438
Small-scale hand methods:					
Wet:					
1942	147	102,485	2,630	92,050	.898
1943	39	5,925	484	16,940	2.859
1944	18	4,100	318	11,130	2.715
1945	19	4,165	112	3,920	.941
1946	23	5,695	96	3,360	.590
Underground placers:					
Drift:					
1942					
1943	2	175	7	245	1.400
1944	1	25	2	70	2.800
1945					
1946	2	2,540	102	3,570	1.406
Grand total placer:					
1942	170	8,226,665	41,242	1,443,470	.175
1943	45	3,222,359	14,072	492,520	.153
1944	24	1,205,475	6,223	217,805	.181
1945	26	1,538,731	9,690	339,150	.220
1946	42	5,769,358	27,986	979,510	.170

[1] First year for which this method was reported used in Montana.

[2] Includes all placer operations using power excavator and washing plant, both on dry land; an outfit with movable washing plant is termed a "dry-land dredge."

Mine production of gold, silver, copper, lead, and zinc in Montana in 1946, by months, in terms of recovered metals

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
January	3,940	349,390	12,292,000	1,444,000	2,284,000
February	3,271	284,253	10,878,000	1,264,000	2,566,000
March	4,016	269,620	10,858,000	1,246,000	3,846,000
April	4,430	101,237	3,252,000	930,000	2,596,000
May	7,115	217,635	9,754,000	1,164,000	3,014,000
June	5,928	263,274	9,448,000	1,592,000	3,118,000
July	7,282	283,453	9,952,000	1,564,000	2,368,000
August	7,412	303,702	10,056,000	1,560,000	3,010,000
September	6,951	279,395	9,424,000	1,190,000	2,700,000
October	6,874	292,508	9,956,000	1,582,000	2,492,000
November	6,133	294,586	10,322,000	1,394,000	2,430,000
December	7,155	334,087	10,770,000	1,630,000	3,116,000
Total: 1946	70,507	3,273,140	116,962,000	16,560,000	33,540,000
1945	44,597	5,942,070	177,012,000	19,998,000	34,806,000

Gold.—Output of gold in Montana in 1946 rose to the highest figure since 1942, for the gold-mining industry recovered a considerable part of its former importance and pushed base-metal mines to a less important position as a source of State gold. Of particular significance was the marked increase in production of placer gold through the resumption of a number of dredge operations, although output from lode-gold mines also gained. Placer mines washed 275 percent more gravel in 1946 than in 1945 and recovered 189 percent more gold; lode mines gained 22 percent in gold output.

Of Montana's total gold in 1946, 39 percent was derived from siliceous gold and silver ores (45 percent in 1945), 21 percent from base-metal ores (33 percent in 1945), and 40 percent from placers (22 percent in 1945). Ores concentrated yielded 20 percent of the State total gold; ores shipped to smelters nearly 17 percent; and ores treated at amalgamation and cyanidation mills (with or without concentrating equipment) 24 percent.

The leading gold producers in Montana in 1946 were the Jardine Mining Co. (gold ore), at Jardine; Winston Bros. (placer), in Jefferson County; Porter Bros. (placer), at Helena; McLaren Gold Mines Co. (copper ore), in Park County; Anaconda Copper Mining Co. (copper ore and waste materials), at Butte and Anaconda; the Golden Sunlight mine (gold ore), near Whitehall; the Drumlummon mine (gold ore), at Marysville; H. & H. Mines (placer) in Granite County; Emigrant Dredging Co. (placer), in Park County; and the U. S. Grant mine (gold-silver ore), near Virginia City. These 10 producers furnished nearly 75 percent of the State total gold.

Silver.—The slump of 2,668,930 ounces from the 1945 output of 5,942,070 ounces brought Montana's production of silver in 1946 to the lowest point since 1933. Most of the loss resulted from a 53-percent decrease in the yield of byproduct silver from the copper-producing operations of the Anaconda Copper Mining Co. at Butte and Anaconda. However, the company supplied 67 percent of the

State total compared with 77 percent in 1945 from its copper mines, mine dumps, tailing dumps, slime ponds, zinc mines, and the North Butte and Flathead mines. Other leading producers of silver in 1946 were the U. S. Grant mine, the Emma & Ophir mine at Butte, and the Mike Horse mine at Flesher.

Copper ore and tailings furnished 64 percent of the State total silver in 1946; zinc-lead ore, 21 percent; siliceous ore, 14 percent; and lead ore and zinc ore, 1 percent. Ore treated at concentrating mills yielded 84 percent of the total silver, and smelting ore, 15 percent; old slag fumed, ores amalgamated or cyanided, and placers were minor sources.

Copper.—For the fourth consecutive year Montana copper output declined in 1946 and was the smallest since 1934. The marked decrease was due largely to a 61-percent reduction in tonnage of crude copper ore and waste material from the properties of the Anaconda Copper Mining Co. at Butte and Anaconda. The company supplied 96 percent of the State total copper in 1946, and the North Butte mine at Butte furnished about half of the remainder. Smaller producers included the Estelle and New Year's Gift, Emma & Ophir, Mike Horse, Travona, and Drake mines.

Lead.—Owing to a reduction of 3,438,000 pounds from the 1945 output, Montana's production of lead in 1946 was the lowest since 1933. The decrease was rather uniformly distributed among all the larger lead producers, with the exception of the slag-fuming plant of the Anaconda Copper Mining Co. at East Helena, which made a gain. The Mike Horse mine near Flesher again was the leading State lead producer, followed in order by the Emma & Ophir mine at Butte, the Jack Waite mine in Sanders County, the slag-fuming plant at East Helena, the Toledo-Buckeye group near Sheridan, and the Poulin and Travona mines at Butte. These seven sources contributed 73 percent of the State total in 1946. Of the State lead output, 84 percent was recovered from zinc-lead ore, 7 percent from lead ore, 6 percent from zinc ore and slag, and 3 percent from siliceous ores.

Zinc.—Zinc in Montana in 1946 held steadier than any of the other five metals except gold, and output fell only 1,266,000 pounds below that in 1945. The slag-fuming plant of the Anaconda Copper Mining Co. at East Helena made an increase of recoverable zinc creditable to Montana, as did the Poulin mine and the Iron Mask mine near Townsend; the Butte Hill waste dumps of the Anaconda Copper Mining Co. at Butte became an important source of zinc in November. The slag-fuming plant was the leading source of the metal in 1946, followed in order by the Emma & Ophir (zinc-manganese ore), Mike Horse (zinc-lead ore), Poulin (zinc ore), Toledo-Buckeye (zinc-lead ore), Travona (zinc-lead ore), Iron Mask (zinc-lead ore), and Anaconda Copper Mining Co. (zinc ore and zinc-lead dump ore). These eight producers supplied 88 percent of the State total zinc. Of Montana's zinc in 1946, 65 percent was derived from zinc-lead ore, 34 percent from zinc ore and old slag, and nearly all the remainder from siliceous gold and silver ores.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Montana in 1946, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Beaverhead	7	2	1,239	$43,365	32,370	$26,155
Broadwater	20	3	3,277	114,695	49,630	40,101
Cascade	6		129	4,515	122,286	98,807
Deer Lodge		1	5	175		
Fergus	1	1	28	980	36	29
Flathead	1		90	3,150	42,323	34,197
Granite	15	4	3,271	114,485	37,958	30,670
Jefferson	29	4	14,322	501,270	58,625	47,369
Judith Basin	2		53	1,855	2,385	1,927
Lewis and Clark	24	7	11,856	414,960	144,291	116,587
Lincoln	1	2	19	665	297	240
Madison	37	3	5,095	178,325	289,010	233,520
Meagher	1		1	35	193	156
Mineral	1	2	28	980	20,865	16,859
Missoula	2	5	2,356	82,460	73	59
Park	4	1	18,561	649,635	32,005	25,860
Phillips	2		2,202	77,070	4,615	2,729
Powell	10	3	686	24,010	10,063	8,131
Ravalli	1		55	1,925	2,969	2,399
Sanders	4	1	307	10,745	5,177	4,183
Silver Bow	25	2	6,926	242,410	2,417,969	1,953,719
Stillwater		1	1	35		
Total: 1946	193	42	70,507	2,467,745	3,273,140	2,644,697
1945	160	26	44,597	1,560,895	5,942,070	4,225,472

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaverhead	37,500	$6,075	358,000	$39,022	42,500	$5,185	$119,802
Broadwater	22,000	3,564	776,000	84,584	1,594,000	194,468	437,412
Cascade	7,000	1,134	743,000	80,987	918,500	112,057	297,500
Deer Lodge							175
Fergus	3,000	486					1,495
Flathead	30,000	4,860					42,207
Granite	101,500	16,443	171,000	18,639	747,000	91,134	271,371
Jefferson	26,500	4,293	594,000	64,746	336,500	41,053	658,731
Judith Basin	500	81	46,000	5,014	20,500	2,501	11,378
Lewis and Clark	286,500	46,413	6,358,000	693,022	13,089,000	1,596,858	2,867,840
Lincoln	100	16	10,400	1,134	19,000	2,318	4,373
Madison	54,000	8,748	948,600	103,397	1 679,000	204,838	728,828
Meagher			15,000	1,635	1,500	183	2,009
Mineral	34,500	5,589	552,000	60,168	173,000	21,106	104,702
Missoula							82,519
Park	356,700	57,785	205,000	22,345	169,000	20,618	776,243
Phillips							80,799
Powell	2,000	324	103,000	11,227	44,000	5,368	49,060
Ravalli	8,500	1,377	29,000	3,161	319,500	38,979	47,841
Sanders	182,700	29,598	938,000	102,242	170,500	20,801	167,569
Silver Bow	115,809,000	18,761,058	4,713,000	513,717	14,216,500	1,734,413	23,205,317
Stillwater							35
Total: 1946	116,962,000	18,947,844	16,560,000	1,805,040	33,540,000	4,091,880	29,957,206
1945	177,012,000	23,896,620	19,998,000	1,719,828	34,806,000	4,002,690	35,405,505

MINING INDUSTRY

Persistent manpower shortages and labor difficulties were the chief factors in reducing Montana's total output of ore and old tailings treated in 1946 by 2,684,604 tons (55 percent) below that in 1945. Declines were especially heavy in the Summit Valley (Butte) district.

The labor shortage was particularly acute at Butte, where it was reported that 3,000 men were needed to reach normal capacity, although toward the end of the year labor over the State became more plentiful.

Labor strikes hampered production but were less serious than in some other Western States. In April a strike lasting 10 days was called at the operations of the Anaconda Copper Mining Co. at Butte. In February a strike became effective at 18 plants of the American Smelting & Refining Co. in 12 States. This strike affected operations for 5 months at the company lead smelter at East Helena, although most large producers were able to stock-pile their concentrates for future shipment and thus not close their mines.

About 80 percent of the total ore and tailings treated in 1946 was copper ore, 10 percent was zinc-lead ore, nearly 7 percent was siliceous gold and silver ores, and less than 4 percent was zinc ore and lead ore.

ORE CLASSIFICATION

Details of ore classification are given in the Gold and Silver chapter of this volume.

Ore sold or treated in Montana in 1946, with content in terms of recovered metals

Source	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	68	113,653	23,815	31,438	12,705	40,329	15,721
Dry and siliceous gold-silver ore	24	19,147	3,516	259,349	13,533	140,283	63,853
Dry and siliceous silver ore	28	16,811	471	162,143	119,351	293,259	245,555
	120	149,611	27,802	452,930	145,589	473,871	325,129
Copper ore	15	1,781,895	11,590	2,082,321	[1] 115,742,329		
Lead ore	32	5,857	634	35,259	18,037	1,086,932	136,953
Zinc ore	6	[2] 73,727	68	16,750	49,481	1,007,902	11,247,210
Zinc-lead ore	37	223,868	2,427	680,526	1,006,564	13,991,295	21,830,708
Total lode mines	[3] 193	2,234,958	42,521	3,267,786	[1] 116,962,000	16,560,000	33,540,000
Placers	42		27,986	5,354			
Total: 1946	235	2,234,958	70,507	3,273,140	[1] 116,962,000	16,560,000	33,540,000
1945	186	4,919,562	44,597	5,942,070	[4] 177,012,000	19,998,000	34,806,000

[1] Includes 6,376,070 pounds recovered from precipitates.
[2] Includes 55,458 tons of old lead smelter slag fumed and 232 tons of old lead smelter slag smelted.
[3] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[4] Includes 5,803,665 pounds recovered from precipitates.

METALLURGIC INDUSTRY

The 2,234,958 tons of ore produced from Montana lode mines in 1946 were treated as follows: 2,005,486 tons (90 percent) at concentrating mills (4,664,259 tons in 1945); 74,535 tons (3 percent) shipped to smelters (183,037 tons in 1945); 55,458 tons (2 percent) of old lead-smelter slag fumed (25,711 tons in 1945); 82,040 tons (4 percent) at cyanidation mills (45,217 tons in 1945); and 17,439 tons (nearly 1 percent) at amalgamation mills (1,338 tons in 1945). The ore that went to concentrating mills comprised 1,761,041 tons of copper ore, 222,054 tons of zinc-lead ore, 17,552 tons of zinc ore, 4,555 tons of siliceous ore, and 284 tons of lead ore.

The 12,320-ton copper concentrator, the 2,000-ton zinc concentrator, and the 2,000-ton slime-disintegrating plant of the Anaconda Copper Mining Co., all at Anaconda, were operated continuously in 1946, but at reduced rates. The company copper smelter (annual capacity, 1,300,000 tons of charge) and the two electrolytic zinc plants at Anaconda and Great Falls (combined capacity, 233,400 tons of slab zinc per year) also were operated throughout the year. The zinc plants treated 401,963 tons of zinc concentrates containing 431,938,462 pounds of zinc, compared with 394,110 tons containing 425,699,262 pounds of zinc in 1945. The concentrates were received from mills in Arizona, Idaho, California, Montana, Nevada, New Mexico, Utah, Colorado, Washington, and several foreign countries. The company zinc-fuming plant at East Helena was operated throughout the year, but at a lower rate than in 1945. The output of zinc-lead fume decreased from 32,233 tons in 1945 to 26,180 tons in 1946; nearly all was treated at the Great Falls zinc plant.

The lead smelter of the American Smelting & Refining Co. at East Helena was closed during the 5-month labor strike. During the period of its operation the plant treated chiefly lead-silver concentrates from the Coeur d'Alene region in Idaho and the Loomis-Oroville district in Washington, residues from the electrolytic-zinc plants at Anaconda and Great Falls, and crude ores, concentrates, and old tailings from various districts in Montana.

Mine production of metals in Montana in 1946, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore amalgamated	17,439	4,805	16,844	2,136	7,079	6,332
Ore cyanided	82,040	11,943	6,174			
Concentrates smelted [1]	2,005,486	14,013	2,744,481	108,817,326	13,734,643	22,728,350
Copper precipitates smelted	4,212			6,376,070		
Ore smelted	[2] 74,535	11,760	492,787	1,766,468	1,898,278	855,318
Old slag fumed	55,458		7,500		920,000	9,950,000
Placer		27,986	5,354			
Total: 1946		70,507	3,273,140	116,962,000	16,560,000	33,540,000
1945		44,597	5,942,070	177,012,000	19,998,000	34,806,000

[1] Includes zinc concentrates treated at electrolytic plants.
[2] Includes 232 tons of old zinc slag smelted.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Montana in 1946, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Ore treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal					
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Broadwater	485	698	302						
Jefferson	305	413	58	6	27	240		1,000	
Lewis and Clark	16,185	1,599	1,052	189	2,029	15,143	2,136	5,986	6,232
Madison	460	25	22	7	9	23		93	100
Silver Bow	4	5	4						
Total: 1946	17,439	2,740	1,438	202	2,065	15,406	2,136	7,079	6,332
1945	1,338	200	40	34	274	2,376	281	2,924	1,455

CYANIDATION MILLS

Park	52,040	9,822	1,760						
Phillips	30,000	2,121	4,414						
Total: 1946	82,040	11,943	6,174						
1945	45,217	7,747	1,592	81	65	28			
Grand total: 1946	99,479	14,683	7,612	202	2,065	15,406	2,136	7,079	6,332
1945	46,555	7,947	1,632	115	339	2,404	281	2,924	1,455

Mine production of metals from concentrating mills in Montana in 1946, by counties, in terms of recovered metals

County	Ore treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Beaverhead	33	20		113	258	7,302	7,249
Broadwater	9,130	2,089	458	42,075	17,913	641,097	1,413,228
Cascade	22,215	1,882	129	121,765	6,987	738,342	915,770
Fergus	50	8	19	36	3,000		
Granite	12,295	770	5	3,168	31,582	23,377	703,364
Lewis and Clark	62,252	7,152	136	113,273	279,162	5,366,967	3,071,692
Lincoln	450	30		297	100	10,400	19,000
Madison	42,219	2,228	372	39,084	51,657	736,355	1,584,839
Mineral	11,763	677	23	20,865	34,500	552,000	173,000
Park	31,795	1,604	5,862	21,688	356,455	113,400	121,472
Powell	1,345	190	145	5,581	810	33,738	33,235
Ravalli	4,480	332	55	2,969	8,500	29,000	319,500
Sanders	3,952	704	78	3,564	58,073	773,346	159,476
Silver Bow	1,803,507	305,117	6,731	2,370,003	114,344,399	4,709,319	14,206,525
Total: 1946	2,005,486	322,803	14,013	2,744,481	115,193,396	13,734,643	22,728,350
1945	4,664,259	421,955	14,296	5,185,676	167,580,134	15,943,151	27,531,118

Gross metal content of concentrates produced from ore mined in Montana in 1946, by classes of concentrates smelted

Class of concentrates	Concentrates (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	296	2,145	15,440	3,863	7,593	7,720
Copper	234,347	11,315	2,058,582	111,396,010		
Lead	9,499	800	188,768	474,484	11,284,932	1,310,748
Zinc	22,197	1,317	357,659	670,790	2,021,008	21,805,571
Zinc-lead	1,510	312	120,552	8,217	729,191	382,086
Dry iron (from copper and zinc-lead ore)	55,156	189	18,886	517,953	9,871	21,176
Total: 1946	323,005	16,078	2,759,887	113,071,317	14,052,595	23,527,301
1945	422,070	14,636	5,188,233	173,941,275	16,376,257	28,557,161

Mine production of metals from Montana concentrates shipped to smelters in 1946, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Beaverhead	20		113	258	7,302	7,249
Broadwater	2,089	458	42,075	17,913	641,097	1,413,228
Cascade	1,882	129	121,765	6,987	738,342	915,770
Fergus	8	19	36	3,000		
Granite	770	5	3,168	31,582	23,377	703,364
Jefferson	6	27	240		1,000	
Lewis and Clark	7,341	2,165	128,416	281,298	5,372,953	3,077,924
Lincoln	30		297	100	10,400	19,000
Madison	2,235	381	39,107	51,657	736,448	1,584,939
Mineral	677	23	20,865	34,500	552,000	173,000
Park	1,604	5,862	21,688	356,455	113,400	121,472
Powell	190	145	5,581	810	33,738	33,235
Ravalli	332	55	2,969	8,500	29,000	319,500
Sanders	704	78	3,564	58,073	773,346	159,476
Silver Bow	305,117	6,731	2,370,003	107,968,329	4,709,319	14,206,525
Total: 1946	323,005	16,078	2,759,887	108,819,462	13,741,722	22,734,682
1945	422,070	14,635	5,188,080	167,580,415	15,946,075	27,532,573

BY CLASSES OF CONCENTRATES

Dry gold	296	2,145	15,440	3,429	7,079	6,332
Copper	234,347	11,315	2,058,582	107,272,184		
Lead	9,499	800	188,768	403,775	11,090,705	1,057,510
Zinc	22,197	1,317	357,659	636,591	1,913,879	21,357,010
Zinc-lead	1,510	312	120,552	7,003	721,755	310,357
Dry iron (from zinc-lead ore)	55,156	189	18,886	496,480	8,304	3,473
Total 1946	323,005	16,078	2,759,887	108,819,462	13,741,722	22,734,682

Gross metal content of Montana crude ore shipped to smelters in 1946, by classes of ore

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	13,704	6,987	8,386	10,468	34,423	11,520
Dry and siliceous gold-silver	15,062	3,270	251,240	12,586	50,332	25,292
Dry and siliceous silver	16,811	471	162,143	143,661	327,715	300,302
Copper	20,854	222	5,607	1,665,592		
Lead	5,573	632	34,728	22,605	1,104,296	162,515
Zinc [1]	717	5	1,588	1,995	30,963	206,054
Zinc-lead	1,814	173	29,095	9,224	422,093	360,562
Total: 1946	74,535	11,760	492,787	1,866,131	1,969,822	1,066,245
1945	183,037	12,325	747,368	3,859,365	4,028,714	3,625,231

[1] Includes 232 tons of old lead smelter slag.

Mine production of metals from Montana crude ore shipped to smelters in 1946, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Beaverhead	5,046	1,050	32,231	37,242	350,698	35,251
Broadwater	1,189	489	7,107	4,087	134,903	180,772
Cascade	11		521	13	4,658	2,730
Flathead	2,020	90	42,323	30,000		
Granite	5,318	314	34,623	69,918	147,623	43,636
Jefferson	17,532	4,538	54,770	26,500	593,000	336,500
Judith Basin	240	53	2,385	500	46,000	20,500
Lewis and Clark	1,068	444	6,542	5,202	65,047	61,076
Madison	15,637	3,894	249,725	2,343	212,152	94,061
Meagher	48	1	193		15,000	1,500
Missoula	32	27	26			
Park	164	2	8,135	245	91,600	47,528
Phillips	55	81	201			
Powell	1,065	432	4,440	1,190	69,262	10,765
Sanders	1,015	197	1,608	124,627	164,654	11,024
Silver Bow	24,095	148	47,957	1,464,601	3,681	9,975
Total: 1946	74,535	11,760	492,787	1,766,468	1,898,278	855,318
1945	183,037	12,325	747,368	3,627,920	3,621,925	2,923,427

BY CLASSES OF ORE

Dry and siliceous gold	13,704	6,987	8,386	9,276	33,250	9,389
Dry and siliceous gold-silver	15,062	3,270	251,240	11,743	46,579	20,532
Dry and siliceous silver	16,811	471	162,143	119,351	293,259	245,555
Copper	20,854	222	5,607	1,598,725		
Lead	5,573	632	34,728	17,887	1,080,742	131,885
Zinc	717	5	1,588	1,749	30,512	168,221
Zinc-lead	1,814	173	29,095	7,737	413,936	279,736
Total 1946	74,535	11,760	492,787	1,766,468	1,898,278	855,318

REVIEW BY COUNTIES AND DISTRICTS

BEAVERHEAD COUNTY

Argenta District.—Ida B. Hand operated the Louis Phillip mine throughout the year and shipped to smelters 763 tons of lead ore containing 138 ounces of gold, 6,178 ounces of silver, 2,752 pounds of copper, 143,273 pounds of lead, and 8,331 pounds of zinc. From the Shafter group 766 tons of gold ore containing 515 ounces of gold and 909 ounces of silver were shipped to a smelter. Remaining district production was 84 tons of lead ore from the Tuscarora mine, 33 tons of zinc-lead ore from the Ferdinand group, and 18 tons of gold ore from the Pine Tree claim.

Bryant District.—Output from the Hecla mine and dumps comprised 390 tons of dump gold-silver ore, 1,267 tons of silver old tailings, 268 tons of old zinc-lead slag, 316 tons of dump lead ore, and 1,084 tons of old lead slag, all shipped to smelters in Utah.

Horse Prairie Creek District.—W. C. McLeod operated a dragline excavator and nonfloating washing plant on the Golden Leaf placer from June 1 to September 15 and recovered 188 ounces of gold and 26 ounces of silver from 70,000 cubic yards of gravel.

Vipond District.—Lessees operated the Quartz Hill Mines group and shipped 90 tons of silver ore to a smelter.

BROADWATER COUNTY

Backer District.—Small lots of high-grade gold ore treated by amalgamation were produced from the Superior group of claims and two small-scale placer operators recovered 7 ounces of gold.

Beaver District.—H. W. Carver, lessee, worked the East Pacific and No. 4 Tunnel claims throughout 1946, milled about 3,000 tons of old gold-silver-lead tailings that made lead concentrate, sent 835 tons of zinc-lead ore to a custom mill in Utah, and shipped 177 tons of zinc-lead ore to a smelter. Remaining production from the district, all shipped to smelters, comprised a total of 178 tons of gold ore from the Custer, Edna No. 2, Joe Dandy, Martha Washington, Vosburg, and Lame Deer properties.

Cedar Plains District.—R. S. Stewart worked the Ruby Silver mine in 1946 and shipped to a smelter 443 tons of ore containing 2 ounces of gold, 1,220 ounces of silver, 629 pounds of copper, 23,251 pounds of lead, and 149,734 pounds of zinc. Other district production was mainly 470 tons of gold ore concentrated from the Keating mine, 236 tons of crude lead ore from the Joe Dandy and Santa Anita properties, 75 tons of gold ore from the Buckhorn and Nada claims, and 17 tons of silver ore from the Spar claim.

Park or Indian Creek District.—The Broadwater Zinc & Lead Co. milled 4,825 tons of zinc-lead ore from its Iron Mask mine; the mill yielded 1,062 tons of zinc concentrate and 317 tons of lead concentrate. Other lode output from the district was largely 470 tons of gold ore amalgamated from the Diamond Hill mine and 54 tons of gold ore shipped direct to a smelter from the Marietta claim. Douglas Placers operated its dragline dredge on Indian Creek from February until Christmas and washed 300,000 cubic yards of gravel.

Mine production of gold, silver, copper, lead, and zinc in Montana in 1946, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Beaverhead County:													
Argenta	5		1,664	685		685	7,891		7,891	2,000	160,000	15,500	$50,006
Bannack		1			1	1							35
Bryant	1		3,325	364		364	23,380		23,380	35,500	198,000	27,000	62,258
Horse Prairie		1			188	188		26	26				6,601
Vipond	1		90	1		1	1,073		1,073				902
Broadwater County:													
Backer	1	2	15	649	7	656	292		292				23,196
Beaver	7		4,190	660		660	18,734		18,734	16,500	299,000	350,500	116,262
Cedar Plains	8		1,244	199		199	2,630		2,630	2,000	66,000	126,500	32,041
Park or Indian Creek	4	1	5,355	137	1,625	1,762	27,828	146	27,974	3,500	411,000	1,117,000	265,913
Cascade County:													
Barker [1]	1		398				1,583		1,583	500	63,000	169,000	28,845
Montana	5		21,828	129		129	120,703		120,703	6,500	680,000	749,500	268,655
Deer Lodge County: Dry Gulch		1			5	5							175
Fergus County:													
North Moccasin		1			9	9							315
Warm Springs	1		50	19		19	36		36	3,000			1,180
Flathead County: Hog Heaven	1		2,020	90		90	42,323		42,323	30,000			42,207
Granite County:													
Alps	1		93	21		21	5		5				739
Boulder and South Boulder	4		259	3		3	1,729		1,729	3,500	8,000	14,000	4,649
Dunkleberg	1		12,255	4		4	3,036		3,036	31,500	23,000	702,500	95,908
First Chance	2	3	68	52	30	82	42		42				2,904
Flint Creek	4		286	9		9	10,255		10,255	1,500	20,000	30,500	14,745
Henderson	2	1	4,615	154	2,922	3,076	22,719	167	22,886	65,000	120,000		149,762
Red Lion	1		37	76		76	5		5				2,664
Jefferson County:													
Amazon	1		75	12		12	542		542	1,000	4,500	3,000	1,876
Cataract	7		279	100		100	6,078		6,078	500	9,500	4,500	10,077
Clancey		4			9,344	9,344		3,557	3,557				329,914
Colorado	5		1,082	113		113	4,859		4,859	7,000	27,000	15,000	13,788
Elkhorn	2		4,768	353		353	37,094		37,094	8,000	230,000	277,500	102,548
Golconda	2		45	26		26	474		474		12,000	1,500	2,784
Mitchell	1		3	6		6	10		10				218
Montana City	1		1	3		3							105
Whitehall	9		11,299	3,927		3,927	5,714		5,714	10,000	310,000	35,000	181,742
Wilson and Ticer Creeks	1		285	438		438	297		297		1,000		15,679
Judith Basin County:													
Barker [1]	1		124	2		2	2,005		2,005		46,000	20,500	9,205
Yogo	1		116	51		51	380		380	500			2,173

Lewis and Clark County:													
Blue Cloud	2		44	19		19	182		182		4,500	500	1,363
Grass Valley	1		9	7		7	5		5				249
Heddleston	1		59,207	92		92	109,786		109,786	277,500	5,296,000	3,032,500	1,084,111
Helena	2	4	10	8	7,641	7,649	5	781	786				268,350
Jefferson Gulch	1		6	8		8							280
Lincoln		1			1	1							35
Marysville	3		16,630	3,918		3,918	17,766		17,766	3,000	23,000	7,500	155,393
McClellan Gulch	1		4	8		8	5		5				284
Ophir Gulch	1		21	26		26	16		16	500			1,004
Rimini	9	1	3,338	121	5	126	8,167		8,167	3,500	109,000	59,500	30,716
Smelter	1		55,690				7,568		7,568	1,000	925,500	9,989,000	1,325,815
Stemple-Gould	1		1	1		1							35
Wolf Creek	1	1	3		1	1	10		10	1,000			205
Lincoln County:													
Cabinet (Fisher River)	1		450				297		297	100	10,400	19,000	3,708
Libby		2			19	19							665
Madison County:													
Cherry Creek	3		17	6		6	224		224				391
McCarthy Mountain	1		100	4		4	474		474	400	25,000	2,000	3,557
Norris and Norwegian	6		585	442		442	417		417		5,200	100	16,386
Pony and South Boulder	2		34	27		27	31		31				970
Renova	1		13	20		20	10		10				708
Rochester	5		1,260	83		83	7,802		7,802	2,500	199,000	103,400	43,920
Sheridan	5	2	42,332	359	36	395	42,380	5	42,385	51,000	712,000	1,570,000	325,482
Silver Star	3		130	241		241	490		490		800		8,918
Tidal Wave	6		475	335		335	859		859	100	6,600	3,500	13,581
Virginia City	5	1	13,370	2,783	759	3,542	236,167	151	236,318				314,915
Meagher County: Castle Mountain	1		48	1		1	193		193		15,000	1,500	2,009
Mineral County:													
Cedar and Trout Creeks		2			5	5							175
Keystone	1		11,763	23		23	20,865		20,865	34,500	552,000	173,000	104,527
Missoula County:													
Coloma	1		19	16		16	10		10				568
Elk Creek	1	3	13	11	50	61	16	5	21				2,152
Nine Mile		2			2,279	2,279		42	42				79,799
Park County:													
Emigrant Creek		1			2,875	2,875		422	422				100,966
Mill Creek	1		5	1		1	323		323	200	200		350
New World	2		31,954	5,863		5,863	29,500		29,500	356,500	204,800	169,000	329,735
Sheepeater	1		52,040	9,822		9,822	1,760		1,760				345,192

See footnote at end of table.

Mine production of gold, silver, copper, lead, and zinc in Montana in 1946, by counties and districts, in terms of recovered metals—Con.

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)			Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total	Lode	Placer	Total				
Phillips County: Little Rockies	2		30,055	2,202		2,202	4,615		4,615				$80,799
Powell County:													
Big Blackfoot	2	2	61	27	105	132	187	42	229		8,000		5,677
Nigger Hill	4		832	45		45	4,792		4,792	1,500	68,500	20,500	15,657
Pioneer	1	1	2	3	4	7	16		16		500	300	350
Zozell	3		1,515	502		502	5,026		5,026	500	26,000	23,200	27,376
Ravalli County: Curlew	1		4,480	55		55	2,969		2,969	8,500	29,000	319,500	47,841
Sanders County:													
Camas Prairie	1		430	8		8	578		578	31,200			5,802
Eagle	1		3,814	8		8	4,052		4,052	13,500	938,000	170,500	128,784
Revais Creek	2		723	259		259	542		542	138,000			31,859
Vermillion		1			32	32		5	5				1,124
Silver Bow County:													
German Gulch		2			42	42		5	5				1,474
Melrose (Camp Creek)	1		60	2		2	542		542				508
Summit Valley (Butte)	24		1,827,546	6,882		6,882	2,417,422		2,417,422	115,809,000	4,713,000	14,216,500	23,203,335
Stillwater County: Basin Creek		1			1	1							35
Total Montana	193	42	2,234,958	42,521	27,986	70,507	3,267,786	5,354	3,273,140	116,962,000	16,560,000	33,540,000	29,957,206

[1]Barker district lies in Cascade and Judith Basin Counties.

CASCADE COUNTY

Barker District.—Output in 1946 was 398 tons of zinc-lead ore shipped to custom mills in Utah from the Fairplay & Bon Ton mine. Gross metal content of the ore was 2 ounces of gold, 1,769 ounces of silver, 684 pounds of copper, 71,095 pounds of lead, and 209,275 pounds of zinc.

Montana District.—The Montana Leasing Co. operated the Benton group until December 1, after which the Lexington Silver & Lead Mines, Inc., took charge. The output—6,469 tons of zinc-lead-silver ore—was treated in the company 100-ton flotation mill and produced 519 tons of zinc-lead-silver concentrate. The Neihart Mine & Milling Co. worked the Broadwater group throughout 1946 and produced 10,248 tons of zinc-lead ore, which was treated in the company 80-ton flotation mill; the ore yielded 334 tons of zinc concentrate and 238 tons of zinc-lead concentrate. The Dacotah group was worked for 7 months by the Bennett Mining Co. and produced 1,900 tons of zinc-lead ore, which was treated in the company 75-ton flotation mill. The Star group was operated throughout the year; 3,200 tons of zinc-lead ore were treated in the 50-ton flotation mill on the property. Remaining district output was 5 tons of zinc-lead-silver ore produced from the Champion B claim.

FERGUS COUNTY

Total production from Fergus County in 1946 was a car of copper milling ore from the Blue Dick claim in the Warm Springs district.

FLATHEAD COUNTY

Hog Heaven District.—Output in 1946 was 2,020 tons of siliceous silver ore from the Flathead mine, operated by the Anaconda Copper Mining Co. The mine closed at midsummer.

GRANITE COUNTY

Alps District.—The Alps Mining & Milling Co. developed its Alps group throughout the year and shipped to a smelter 93 tons of gold ore containing 21 ounces of gold and 5 ounces of silver.

Boulder and South Boulder District.—The bulk of the output in 1946 was 203 tons of silver ore shipped to a smelter from the Brooklyn group and 40 tons of gold-silver ore from the Mediterranean claim, treated in a 50-ton flotation mill on the property.

Dunkleberg District.—The Forest Rose, Wasa, and Monarch claims of the Forest Rose Syndicate were operated only until June. The company 100-ton flotation mill treated 12,255 tons of zinc ore, which yielded 34 tons of lead concentrate and 732 tons of zinc concentrate.

First Chance District.—Lode production was principally 60 tons of gold smelting ore from the Fairview claim. Small-scale placering recovered 30 ounces of gold from the Lucky Jim, Overlook, and Lehson's No. C claims.

Flint Creek District.—From its Trout group the Trout Mining Division of American Machine & Metals, Inc., shipped to a smelter 103 tons of zinc-lead ore containing 2 ounces of gold, 3,354 ounces of

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silver, 250 pounds of copper, 11,872 pounds of lead, and 16,304 pounds of zinc. Remaining district production was mainly 104 tons of silver ore and 57 tons of zinc-lead ore from the Moorlight (True Fissure) group.

Henderson District.—The connected-bucket dredge of the H. & H. Mines on Henderson Creek was operated from March 13 to September 10; gold output was considerably less than in 1945. From the Combination group, Ben Walkup shipped to a smelter 4,600 tons of old silver tailings.

Red Lion District.—High-grade gold ore (37 tons) was shipped to a smelter from the Glittering Hill claim.

JEFFERSON COUNTY

Amazon District.—From the East Mint claim 75 tons of gold-silver ore were shipped to a smelter; metal content was 12 ounces of gold, 542 ounces of silver, 1,321 pounds of copper, 4,631 pounds of lead, and 3,750 pounds of zinc.

Cataract District.—J. K. Curtiss operated the Morning Glory mine throughout 1946 and shipped to a smelter 139 tons of ore containing 24 ounces of gold and 4,986 ounces of silver. Remaining district production was largely 49 tons of gold ore from the Boulder claim, 28 tons of gold-silver ore from the Comet dump, and 26 tons of lead ore from the Klondyke claim.

Clancey District.—Idle since October 15, 1942, Winston Bros. resumed operations May 12, 1946, with its connected-bucket dredge on Prickly Pear Creek and to the end of the year handled 1,413,761 cubic yards of gravel. The dredge is equipped with 86 6-cubic foot buckets. The N. Rogers Gold Mining Co. operated the Jefferson Placers from February 18 to the end of the year with a 1½-cubic yard dragline dredge, a ¾-cubic yard power shovel, and a nonfloating washing plant. Remaining output from the district was a small quantity of gold recovered by hand placering.

Colorado District.—The principal output in 1946 was 863 tons of ore (containing 76 ounces of gold, 3,540 ounces of silver, 1,487 pounds of copper, 22,449 pounds of lead, and 14,264 pounds of zinc) shipped to a smelter from the Blizzard waste dump. Other district production, all shipped to smelters, was mainly 136 tons of gold-silver ore from the Blue Bird group, 44 tons of copper ore from the Chalcopyrite mine, and 34 tons of gold-silver ore from the Mount Washington property.

Elkhorn District.—The bulk of the production in 1946 came from the Elkhorn property. The output (3,769 tons of old silver tailings and 287 tons of crude silver ore) was shipped to smelters. Remaining district production was 712 tons of lead-silver ore shipped to a smelter from the Elkhorn Queen mine.

Golconda District.—The Mines Development Co. operated the Gold Coin claim and shipped to a smelter 32 tons of ore containing 23 ounces of gold, 306 ounces of silver, 5,547 pounds of lead, and 1,856 pounds of zinc. Remaining district production was 13 tons of lead ore shipped to a smelter from the Big Chief claim.

Whitehall District.—The Golden Sunlight mine, operated by Marvin F. Riebhoff, was again the largest producer in the Whitehall district;

output was 9,838 tons of gold ore shipped to a smelter. George W. Wolfe operated the Lucky Hit mine throughout the year and shipped to smelters 332 tons of gold ore containing 218 ounces of gold, 523 ounces of silver, 2,281 pounds of copper, 20,498 pounds of lead, and 11,520 pounds of zinc. Remaining district output, all shipped to smelters, comprised 1,061 tons of lead ore from the Carbonate, Surprise, Iron Side, Minerva, and Perhaps properties; 36 tons of silver ore from the Florence Fraction claim; and 32 tons of gold ore from the Sunny Corner mine.

Wilson and Ticer Creeks District.—The Callahan Mining Syndicate worked the Deer Horn Nos. 1, 2, and 3 claims a short time in 1946 and milled 285 tons of gold ore by amalgamation and concentration.

JUDITH BASIN COUNTY

Barker District.—The Faith Mining Co. operated its group of claims and shipped 124 tons of zinc-lead-silver ore to a smelter.

Yogo District.—Walter C. Lehman worked the Gold Bug mine a few months in 1946 and shipped to a smelter 116 tons of ore containing 51 ounces of gold, 380 ounces of silver, and 538 pounds of copper.

LEWIS AND CLARK COUNTY

Blue Cloud District.—Output of the Blue Cloud district in 1946 was 31 tons of gold ore produced from the Pearl claim and 13 tons of silver-lead ore from the Lincoln mine.

Heddelston District.—The Mike Horse Mining & Milling Co., a subsidiary of the American Smelting & Refining Co., operated the Mike Horse mine throughout 1946 and treated 59,207 tons of zinc-lead ore in the company 250-ton flotation mill; the mill yielded 4,388 tons of lead concentrate and 2,544 tons of zinc concentrate containing 92 ounces of gold, 109,786 ounces of silver, 310,318 pounds of copper, 5,379,789 pounds of lead, and 3,198,283 pounds of zinc.

Helena District.—Porter Bros. Corp. operated its 6-cubic-foot Yuba dredge on Last Chance Gulch throughout the year and washed 1,903,323 cubic yards of gravel. Remaining lode and placer production from the district was very small.

Marysville District.—The Montana Rainbow Mining Co. operated the Drumlummon mine continuously in 1946 and milled 16,182 tons of gold ore in its 160-ton amalgamation and concentration plant. The rest of the district output was 432 tons of gold ore shipped to a smelter from the Belmont-Cruse group and 16 tons of lead ore produced from the Empire property.

Ophir Gulch District.—Total production was 21 tons of gold ore shipped to a smelter from the Victory claim.

Rimini District.—In 1946 about 3,000 tons of zinc-lead ore from the Valley Forge waste dump were treated in the flotation mill of the Rimini Milling Co., and 45 tons of gold-silver ore from the Lee Mountain waste dump were concentrated. Output of smelting ore was mainly 9 tons of gold-silver ore, 48 tons of lead ore, and 56 tons of zinc-lead ore from the Bunker Hill claim, 30 tons of gold ore from the Clementh claim, 21 tons of lead ore from the Copper Dyke mine, 33 tons of zinc-lead ore from the Lexington claim, 30 tons of gold-silver ore from the Eureka claim, and 58 tons of lead ore from the Anna May

& Broadway group. Hand placering on the Gould claim recovered 5 fine ounces of gold.

Smelter District.—As in previous years, the bulk of production in the Smelter district in 1946 came from operations of the Anaconda Copper Mining Co. slag-fuming plant at East Helena. Hot slag and cold slag treated at the plant totaled 161,306 tons in 1946, compared with 197,244 tons in 1945, but only the metals recovered from fuming 55,458 tons of old cold lead-smelter slag were credited to the plant as a producer in the Smelter district. The remaining metals, after elimination of material from foreign sources, were credited to the individual domestic mines producing the ores and concentrates that yielded the current hot slag treated in the slag-fuming plant. The American Smelting & Refining Co. resmelted 232 tons of old zinc slag during the year.

LINCOLN COUNTY

Cabinet (Fisher River) District.—The Silver Butte Zinc-Lead Mining Co. milled about 450 tons of zinc-lead ore from the Silver Butte claim in 1946; it yielded 20 tons of zinc concentrate and 10 tons of zinc-lead concentrate.

Libby District.—The Liberty and Comet placer claims produced 19 ounces of gold.

MADISON COUNTY

Cherry Creek District.—Output in 1946 was 17 tons of gold-silver smelting ore from the Gold Plate, Kennebeck, and Lucky Strike claims.

McCarthy Mountain District.—L. B. Lively worked the Polly Jane claim in 1946 and shipped 100 tons of lead ore to a smelter.

Norris and Norwegian District.—A. J. Theis operated the Boaz group throughout the year and shipped to smelters 102 tons of ore containing 377 ounces of gold, 231 ounces of silver, and 5,230 pounds pounds of lead. Remaining district output was mainly 400 tons of gold old tailings from the Revenue dump and 66 tons of gold ore from the Emperor mine.

Pony and South Boulder District.—Output was principally 33 tons of gold ore from the Little King group.

Renova District.—Total output in 1946 was 13 tons of gold ore from the Mary Ingaber claim.

Rochester District.—Lessees worked the Calvin group continuously in 1946 and shipped 795 tons of zinc-lead ore to a smelter in Utah. The rest of the district output was principally 155 tons of zinc-lead ore and 81 tons of gold-silver ore produced from the Emma group and 220 tons of lead ore from the Cooper property.

Sheridan District.—Victoria Mines, Inc., operated the Toledo-Buckeye group throughout 1946 and treated 42,064 tons of zinc-lead ore in the company 125-ton flotation mill which yielded 606 tons of lead concentrate and 1,550 tons of zinc concentrate. Wm. E. Horton worked the Silver Bullion group under lease all year and shipped to a smelter 188 tons of ore containing 3 ounces of gold and 3,928 ounces of silver; 72 tons of similar ore were produced by the Mitchell Mining Co. from the Goldsmith group. The remainder of the district output

was chiefly 36 fine ounces of gold and 5 fine ounces of silver recovered from 2 placer properties.

Silver Star District.—Output in 1946 was largely 105 tons of high-grade gold ore shipped to a smelter from the Stella mine and 20 tons of low-grade gold ore amalgamated from the Green Campbell waste dump.

Tidal Wave District.—Gold ore shipped to smelters was produced in 1946 from the Corncracker mine (104 tons); the Gold Crest mine (35 tons); the Granger group (47 tons); and the Smith & Thompson property (153 tons). Remaining district output was principally 79 tons of gold ore and 54 tons of lead ore from the High Ridge and High Ridge Fraction claims.

Virginia City District.—The U. S. Grant Mining Co. operated its U. S. Grant mine throughout the year and shipped to a smelter 12,919 tons of ore containing 2,702 ounces of gold and 234,612 ounces of silver. Gold-silver ore also was shipped from the Alameda & Wa Koosta property (227 tons), the Eureka claim (51 tons), and the Forkes claim (24 tons). From the Bamboo Chief mine 149 tons of gold ore were shipped to a smelter. Russell Unrue worked the Barton Gulch placer with a dragline dredge and washed 103,400 cubic yards of gravel from mid-May to late September.

MEAGHER COUNTY

The total output of Meagher County in 1946 was 48 tons of lead ore shipped to a smelter from the Yellowstone claim in the Castle Mountain district.

MINERAL COUNTY

Keystone District.—E. G. Smith worked the Nancy Lee group throughout 1946 and treated 11,763 tons of zinc-lead ore in the 100-ton flotation mill on the property.

MISSOULA COUNTY

Coloma District.—Output was 19 tons of gold ore shipped to a smelter from the Mammoth group.

Elk Creek District.—Lode production in 1946 was 13 tons of gold ore shipped to a smelter from the Cato claim. Linton & Austin worked the Elk Creek placer for a month with a 1½-cubic-yard dragline dredge and recovered 46 fine ounces of gold and 5 fine ounces of silver. Small-scale placering recovered an additional 4 ounces of gold from claims in the district.

Nine Mile District.—Canusco, Inc., successors to the Beaver Dredging Co., operated a 2½-cubic-yard dragline dredge on the Housum group of placer claims from April through December and recovered 2,276 fine ounces of gold and 42 fine ounces of silver. Hydraulicking and sluicing at the Crysalis placer recovered 3 fine ounces of gold.

PARK COUNTY

Emigrant Creek District.—After having been idle since October 15, 1942, the Emigrant Dredging Co. resumed operations April 22, 1946, with its connected-bucket dredge on the Hefferlin group of placer

claims in Emigrant Gulch and during the rest of the year handled 947,320 cubic yards of gravel. The dredge is equipped with 110 10-cubic-foot buckets.

New World District.—The McLaren Gold Mines Co. operated the Estelle mine continuously in 1946 and treated 30,735 tons of copper-gold ore in the company 200-ton flotation mill; it yielded 1,397 tons of copper concentrate containing 5,859 ounces of gold, 8,483 ounces of silver, and 371,059 pounds of copper. A total of 1,219 tons of zinc-lead ore was produced in 1946 from the Irma mine; 1,060 tons were treated by flotation and 159 tons of ore were shipped direct to a smelter.

Sheepeater District.—The Jardine Mining Co. operated its Jardine mine and 300-ton cyanide mill throughout the year; 52,040 tons of gold ore were treated by cyanidation and yielded 9,822 fine ounces of gold and 1,760 fine ounces of silver.

PHILLIPS COUNTY

Little Rockies District.—The Ruby Gulch Mining Co. resumed operations at the Ruby group July 1, 1946, after having been inactive since August 1942. In 1946 about 30,000 tons of gold ore were treated in the company 300-ton cyanidation mill; the yield was 2,121 ounces of gold and 4,414 ounces of silver. Remaining district production was 55 tons of gold smelting ore from the Little Ben mine.

POWELL COUNTY

Big Blackfoot District.—W. A. Noon developed the Marcum Hill claim in 1946 and shipped a car of lead ore to a smelter. John B. Hopkins worked the Hopkins drift mine from May through December and sluiced about 2,500 cubic yards of gravel. Remaining lode and placer output from the district was small.

Nigger Hill District.—Hopkins & Sons Mining Co., lessees, operated the Charter Oak mine throughout the year, shipped 473 tons of lead ore to a smelter, and treated 284 tons of zinc-lead ore in the 40-ton flotation mill on the property. From the Sunnyside & Sunset group 61 tons of zinc-lead ore were shipped to a custom mill in Utah for treatment. Remaining district output was 14 tons of lead ore produced from the Flora Best and Negros claims.

Zozell District.—The Bonanza Leasing Co. operated the Bonanza group from June through December and shipped to a smelter 440 tons of ore containing 339 ounces of gold and 183 ounces of silver. The Deer Lodge Mining Co. worked the Emery group and milled about 1,000 tons of gold-silver ore, which produced 163 tons of zinc-lead concentrate. Remaining district production was 70 tons of gold ore and 5 tons of lead ore produced from the Hidden Hand group.

RAVALLI COUNTY

Curlew District.—C. A. Tout operated the Curlew mine nearly all year and milled 4,480 tons of zinc ore by flotation which yielded 288 tons of zinc concentrate, 28 tons of zinc-lead concentrate, and 16 tons of lead concentrate.

SANDERS COUNTY

Camas Prairie District.—Laurence G. Howard operated the Glaucus & Cardiff mine all of 1946 and shipped to a smelter 430 tons of ore containing 8 ounces of gold, 578 ounces of silver, and 32,397 pounds of copper.

Eagle District.—The Jack Waite mine was worked the entire year by the American Smelting & Refining Co. Of the output (3,814 tons), 117 tons of lead ore were shipped to a smelter and 3,697 tons of zinc-lead ore were treated in the company 400-ton flotation mill at Duthie, Idaho; the yield was 523 tons of lead concentrate and 130 tons of zinc concentrate.

Revais Creek District.—Following a fire in 1945 that destroyed all the surface plant, the Green Mountain Mining Co. resumed operations at the Drake group June 1, 1946, and during the rest of the year shipped 421 tons of copper ore to a smelter and treated about 255 tons of similar ore in the rebuilt 50-ton flotation mill. Remaining district output was 47 tons of copper smelting ore from the Lucky Strike claim.

Vermillion District.—The Pringle Dredging & Mining Co. operated a Becker-Hopkins suction dredge on Trout Creek for a few weeks in 1946 and recovered 32 ounces of gold and 5 ounces of silver.

SILVER BOW COUNTY

Ore production in Silver Bow County declined 60 percent from that in 1945, resulting in decreases of 45 percent in gold output, 51 percent in silver, 34 percent in copper, 19 percent in lead, and 16 percent in zinc. The total value of the five metals produced in 1946 dropped 23 percent below that in 1945. The following table gives the output of mines in Silver Bow County, which includes the Summit Valley (Butte) district, in 1945 and 1946 and the total from 1882 to the end of 1946.

Production of gold, silver, copper, lead, and zinc in Silver Bow County, Mont., 1945–46, and total, 1882–1946, in terms of recovered metals

Year	Mines producing	Ore (short tons)	Gold (lode and placer) (fine ounces)	Silver (lode and placer) (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
1945	24	4,528,282	12,484	4,976,910	175,899,200	5,851,500	16,986,400	$30,179,133
1946	27	1,827,606	6,962	2,417,969	115,809,000	4,713,000	14,216,500	23,205,317
1882–1946		[1]	2,026,233	545,784,979	[2] 6,543,819	[2] 234,862	[2] 1,570,769	2,599,412,012

[1] Figure not available.
[2] Short tons.

German Gulch District.—Hydraulicking and hand placering at the Beal Hill and Agnes placers recovered 42 ounces of gold and 5 ounces of silver.

Melrose (Camp Creek) District.—Output was 60 tons of silver ore from the Old Glory claim.

Summit Valley (Butte) District.—The copper concentrator of the Anaconda Copper Mining Co. at Anaconda treated 1,187,143 tons of copper ore from company-owned Butte mines in 1946, compared

with 1,747,946 tons in 1945, a decline of 32 percent; 4,203 tons of copper mine-water precipitates were produced, compared with 4,114 tons in 1945. Additional material treated in the concentrator was as follows (1945 figures in parentheses); New Works sand tailings, none (591,914 tons); mixed Butte slime and tailings, 171,646 tons (905,001 tons); mine dumps, none (424,684 tons); special waste 29,286 tons (64,375 tons); and East Project ore and Special Exploration project (Adams ore), 53,671 tons (none). Direct-smelting ore totaled 19,846 tons.

Total slimes treated at the slime-disintegrating plant in 1946 comprised 252,462 tons of New Works Valley Pond slimes, compared with 283,831 tons from the same source in 1945; the total from all sources in 1945 was 548,216 tons.

The contract between the Anaconda Copper Mining Co. and the North Butte Mining Co. for operation of the North Butte mine was terminated March 31, and in July the North Butte Mining Co. assumed control of the property. Output for the year was 35,793 tons of copper milling ore and 9 tons of copper mine-water precipitates.

Zinc ore mined from the zinc mines of the Anaconda Copper Mining Co. totaled 766 tons in 1946. In November the company began treating zinc-lead ore from the Butte Hill waste dumps at Butte and during the rest of the year treated 31,973 tons. The operation rapidly became a major source of Montana zinc and an important source of lead. The initial product is a bulk zinc-lead concentrate, which is further separated into zinc concentrate and lead concentrate. The company continued operating the Emma & Ophir mine under lease and produced 21,305 tons of zinc-lead middling from the treatment of manganese-zinc ore. In addition, 5,791 tons of zinc-lead middling were produced in milling manganese-zinc ore from the Travona mine; the middling was treated further at the Anaconda zinc concentrator.

Lessees of the Anaconda Copper Mining Co. operated a number of properties at Butte during the year and produced 17,403 tons of ore, of which 12,662 tons (zinc-lead ore) came from the Poulin mine. The remainder of the district output was mainly 211 tons of silver ore from the Bluebird and Mona claims and 142 tons of gold-silver ore from the Ruby mine.

Nevada
Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By ALFRED L. RANSOME

	PAGE		PAGE
General summary	1473	Mining industry	1479
Calculation of value of metal production	1474	Ore classification	1479
Mine production by counties	1478	Metallurgic industry	1480
		Review by counties and districts	1484

GENERAL SUMMARY

THE QUANTITY and value of zinc produced in Nevada in 1946 attained the highest levels in the history of the State, surpassing the previous record of 1945 by 6 percent in quantity and 12 percent in value. In contrast, gold output was 2 percent below the total for 1945 and was the lowest in quantity since 1895. Copper production decreased 8 percent to the lowest point since 1938, but the output of silver and lead was up 20 and 14 percent, respectively, above the totals for 1945. The total value of gold, silver, copper, lead, and zinc recovered from ore, old tailings, and gravels in Nevada in 1946 was $27,026,416 compared with $24,186,294 in 1945—an increase of 12 percent—owing to a greater average price for all metals except gold. As a result of this price increase, the total value of copper produced in 1946 was 11 percent above the value of the greater output in 1945. Increased output was largely a matter of incentive resulting from higher prices and was accomplished in spite of continued rising costs of labor, supplies, and equipment. Also, for the first year since the war, labor was beginning to become more available.

Comparing 1946 with 1945, gold output decreased 2 percent in quantity and value, and copper decreased 8 percent in quantity but advanced 11 percent in value; silver increased 20 percent in quantity and 36 percent in value; lead increased 14 percent in quantity and 45 percent in value; and zinc advanced 6 percent in quantity and 12 percent in value. Of the total value of the five metals, copper comprised 58 percent; zinc, 20 percent; gold, 12 percent; lead, 6 percent; and silver, 4 percent.

White Pine County continued its lead over the other counties by producing 62 percent of the State total value of the five metals; it stood first in output of copper and gold, second in silver, third in zinc, and fifth in lead. Lincoln County ranked second to White Pine County, with 20 percent of the State total value; it led the State in production of silver, lead, and zinc.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

Yardage figures used in measuring material treated in placer operations are "bank measure"; that is, the material is measured in the ground before treatment.

The value of metal production herein reported has been calculated at the following prices:

Prices of gold, silver, copper, lead, and zinc, 1942–46

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per ounce fine	*Per ounce fine*	*Per pound*	*Per pound*	*Per pound*
1942	$35.00	$0.711+	$0.121	$0.067	$0.093
1943	35.00	711+	.130	.075	.108
1944	35.00	711+	.135	.080	.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] Treasury buying price for newly mined silver. 1942 to June 30, 1946: $0.71111111; July 1 to Dec. 31, 1946: $0.905.
[3] Yearly average weighted price of all grades of primary metal sold by producers; price includes bonus payments by Office of Metals Reserve for overquota production.

Mine production of gold, silver, copper, lead, and zinc in Nevada, 1942–46, and total, 1859–1946, in terms of recovered metals

Year	Mines producing [1]		Ore, old tailings, etc. (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1942	434	49	9,383,379	295,112	$10,328,920	3,723,435	$2,647,776
1943	168	17	8,364,043	144,442	5,055,470	1,620,280	1,152,199
1944	146	11	6,863,505	119,056	4,166,960	1,259,636	895,741
1945	163	12	5,374,673	92,265	3,229,275	1,043,380	741,959
1946	193	33	5,725,805	90,680	3,173,800	1,250,651	1,010,526
1859–1946 [2]			[3]	25,517,001	571,656,711	589,603,712	540,726,602

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1942	167,326,000	$20,246,446	10,752,000	$720,384	20,394,000	$1,896,642	$35,840,168
1943	142,136,000	18,477,680	9,580,000	718,500	27,294,000	2,947,752	28,351,601
1944	122,464,000	16,532,640	13,210,000	1,056,800	41,398,000	4,719,372	27,371,513
1945	105,190,000	14,200,650	12,550,000	1,079,300	42,914,000	4,935,110	24,186,294
1946	97,232,000	15,751,584	14,350,000	1,564,150	45,298,000	5,526,356	27,026,416
1859–1946 [2]	[4] 1,782,668	505,703,522	[4] 547,180	60,247,517	[4] 347,488	55,488,516	1,733,822,868

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] From 1904 (when first satisfactory annual canvass of mine production was made) to 1946, inclusive, the output was as follows: Gold, 13,690,124.51 ounces valued at $327,173,478; silver, 301,190,863 ounces, $203,568,379; copper, 1,780,742 tons, $505,056,894; lead, 309,389 tons, $37,610,955; zinc, 347,488 tons, $55,488,516; total value, $1,128,898,222.
[3] Figure not available. [4] Short tons.

Gold.—Gold production in Nevada in 1946, decreasing 2 percent below the 1945 output, was the lowest in quantity since 1895 and in value since 1933. Continued rising costs of labor, supplies, and equipment left little room for incentive to mine gold at the established and unchanged price. Although output from a larger number of placer mines increased 55 percent above the total for 1945, gold from lode mines—which accounted for 84 percent of the State's total gold production—declined 8 percent. Monthly production of gold, as shown in the accompanying table, was erratic, with no definite trend indicated. Byproduct gold from base-metal ores comprised 52 percent of the output of gold, again exceeding the gold recovered from precious-metal ores, which was 32 percent of the total.

The 10 leading gold-producing mines in 1946 produced 88 percent of Nevada's output, the three leaders contributing 58 percent.

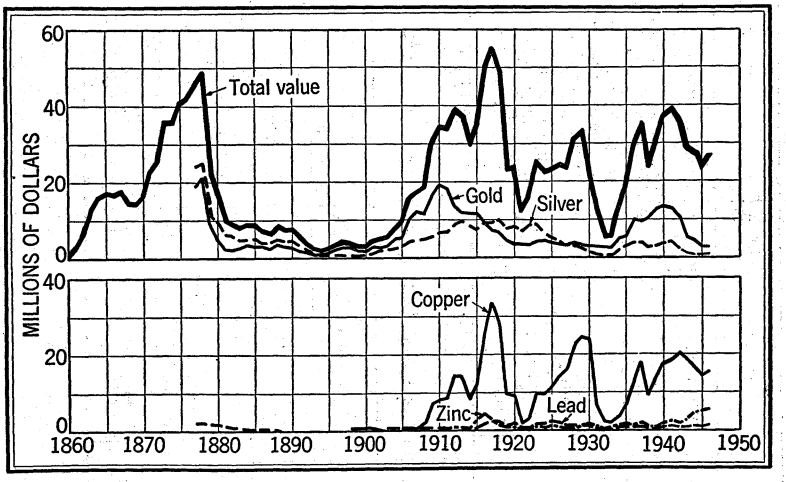

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Nevada 1860–1946.

Silver.—As in preceding years, most of the silver output of Nevada was a byproduct of ore mined chiefly for other metals. Base-metal ores were the source of 80 percent of the State's silver production in 1946; only 5 percent of the silver was derived from straight silver ore. The monthly production figures in the accompanying table show a higher level of output during the latter half of 1946, with no special trend indicated. The 10 leading silver-producing mines in Nevada in 1946 produced 65 percent of the State total recoverable silver, the first three yielding 34 percent of the total.

Ten leading gold-producing mines in Nevada in 1946, in order of output

Rank	Mine	District	County	Rank in 1945	Operator	Source of gold
1	Ruth and Copper Flat Pit	Robinson	White Pine	1	Kennecott Copper Corp. (Nevada Mines Division).	Copper ore.
2	Coppermines group	do	do	2	Consolidated Coppermines Corp	Do.
3	Manhattan dredge	Manhattan	Nye	4	Manhattan Gold Dredging Co	Dredge.
4	Goldacres	Bullion	Lander	5	Willow Creek Mines, Inc. and Consolidated Goldacres Co.	Gold ore.
5	Overman	Comstock	Storey	(1)	Consolidated Chollar, Gould & Savage	Do.
6	Copper Canyon	Battle Mountain	Lander	6	Copper Canyon Mining Co	Copper ore.
7	Pioche group	Pioche	Lincoln	8	Combined Metals Reduction Co., & Raymond Ely West Mining Co.	Zinc-lead ore.
8	Standard	Echo (Rye Patch)	Pershing	(1)	Standard Cyaniding Co	Gold ore.
9	Gilded Age	Osceola	White Pine	11	Gilded Age Mining Co	Do.
10	Divide	Gold Mountain (Divide)	Esmeralda	7	Tonopah Divide Mining Co	Do.

[1] Did not produce in 1945.

Ten leading silver-producing mines in Nevada in 1946, in order of output

Rank	Mine	District	County	Rank in 1945	Operator	Source of gold
1	Pioche group	Pioche	Lincoln	1	Combined Metals Reduction Co. & Raymond Ely West Mining Co.	Zinc-lead ore.
2	Ruth and Copper Flat pit	Robinson	White Pine	2	Kennecott Copper Corp	Copper ore.
3	Bristol Silver	Jack Rabbit	Lincoln	8	Bristol Silver Mines Co	Do.
4	Cleveland	Delano	Elko	3	McFarland & Hullinger	Lead ore.
5	Tonopah Mining Co	Tonopah	Nye	9	Tonopah Mining Co. of Nevada	Gold-silver ore.
6	Prince	Pioche	Lincoln	6	Prince Consolidated Mining Co	Zinc-lead ore and gold silver ore.
7	Copper Canyon	Battle Mountain	Lander	5	Copper Canyon Mining Co	Copper ore.
8	Overman	Comstock	Storey	(1)	Consolidated Chollar, Gould & Savage	Gold ore.
9	Coppermines group	Robinson	White Pine	4	Consolidated Coppermines Corp	Copper ore.
10	Mt. Hope	Eureka	Eureka	12	Callahan Zinc-lead Co	Zinc-lead ore.

[1] Did not produce in 1945.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1946, by months, in terms of recovered metals

Month	Gold (fine ounces)	Silver (fine ounces)	Cepper (short tons)	Lead (short tons)	Zinc (short tons)
January	6,967	102,243	4,083	616	1,820
February	7,582	99,540	4,083	616	1,948
March	7,379	93,781	4,849	561	2,204
April	8,709	90,491	4,900	561	2,381
May	6,968	96,954	4,440	645	2,548
June	7,582	98,247	4,772	460	2,007
July	5,636	113,407	2,144	493	1,574
August	7,685	117,638	3,369	616	1,673
September	7,172	115,170	3,471	616	1,525
October	6,967	99,892	3,726	645	1,623
November	9,836	111,644	4,287	673	1,673
December	8,197	111,644	4,492	673	1,673
Total 1946	90,680	1,250,651	48,616	7,175	22,649

Copper.—The three leading copper producers in Nevada in 1946 accounted for 98 percent of the copper output; these were: The Kennecott Copper Corp. (Nevada Mines Division), working the Ruth and the Copper Flat open-pit mines, and the Consolidated Coppermines Corp., working the Coppermines group at Kimberly (all in the Robinson district, White Pine County); and the Mountain City Copper Co., working the Mountain City mine at Mountain City (in the Cope district, Elko County). The monthly production of copper fluctuated rather widely during the year, reaching a high point of 4,900 short tons in April; the low point of 2,144 tons in July was followed by a steady rise to 4,492 tons in December.

Lead.—Of the recoverable lead produced in Nevada in 1946, 49 percent was mined in the Pioche district, Lincoln County, where the leading properties were: The Combined Metals Reduction Co., working the Pioche No. 1 and 2 groups and also the Raymond Ely West property, Ely Valley mine, operated by Ely Valley Mine, the Prince mine, operated by the Prince Consolidated Mining Co., and the Financier mine, operated under lease from the Salt Lake Pioche Mining Co. Other important producers in the State were: The B. B. S. Mining Corp. and Wilson & Simpson, working the Simon Lead mine (Bell district, Mineral County); McFarland & Hullinger, Cleveland mine (Delano district, Elko County); Nevada Lead & Zinc Co., Nevada Lead mine (Spruce Mountain district, Elko County); the International Mining Corp. and Dan Sheahan, Groom mine (Groom district, Lincoln County); and the Bristol Silver Mines Co., Bristol Silver mine (Jack Rabbit district, Lincoln County). The monthly State total production of lead showed a decline during the first half of 1946 followed by an upward trend during the second half, the December total being 9 percent above that for January.

Zinc.—In 1946, as in recent years, zinc production in Nevada was centered in the Pioche district, Lincoln County, where 70 percent of the State total for the year was mined. The Combined Metals Reduction Co. (including the Raymond Ely West property) and Ely Valley Mine were the State's leading producers, in that order; both are in the Pioche district. Other important producers in the State were: Callahan Zinc-Lead Co., Mount Hope mine (Eureka district, Eureka County); Prince Consolidated Mining Co., Prince mine

(Pioche district, Lincoln County); Grand Deposit Mining Co., Grand Deposit mine (Aurum district, White Pine County); Sam Robinson, Columbia mine (Robinson district, White Pine County); and Nevada Lead & Zinc Co., Nevada Lead mine (Spruce Mountain district, Elko County). The monthly State total production figures in the accompanying table show a gradual increase during the first 5 months of 1946 to the high point of the year in May. Output during the latter half of the year showed some fluctuation, followed by a leveling during the fourth quarter at a point below the general level of the first 6 months.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1946, by counties, in terms of recovered metals

County	Mines producing [1]		Gold						Silver (lode and placer)	
			Lode		Placer		Total			
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Churchill	7	-------	187	$6,545	-------	-------	187	$6,545	3,026	$2,445
Clark	15	-------	968	33,880	-------	-------	968	33,880	43,645	35,265
Elko	17	-------	269	9,415	-------	-------	269	9,415	132,630	107,165
Esmeralda	10	1	1,687	59,045	3	$105	1,690	59,150	6,084	4,916
Eureka	2	2	40	1,400	17	595	57	1,995	43,429	35,091
Humboldt	9	1	577	20,195	6	210	583	20,405	404	327
Lander	12	3	16,626	581,910	273	9,555	16,899	591,465	66,900	54,055
Lincoln	19	-------	3,451	120,785	-------	-------	3,451	120,785	500,505	404,408
Lyon	15	2	1,184	41,440	1,070	37,450	2,254	78,890	14,655	11,841
Mineral	7	5	189	6,615	24	840	213	7,455	56,866	45,948
Nye	22	5	1,269	44,415	13,171	460,985	14,440	505,400	104,760	84,646
Pershing	11	13	2,313	80,955	221	7,735	2,534	88,690	6,639	5,364
Storey	6	-------	5,419	189,665	-------	-------	5,419	189,665	50,854	41,090
Washoe	7	-------	228	7,980	-------	-------	228	7,980	10,743	8,680
White Pine	34	1	41,487	1,452,045	1	35	41,488	1,452,080	209,511	169,285
Total: 1946	193	33	75,894	2,656,290	14,786	517,510	90,680	3,173,800	1,250,651	1,010,526
1945	163	12	82,705	2,894,675	9,560	334,600	92,265	3,229,275	1,043,380	741,959

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Churchill	-------	-------	14,000	$1,526	-------	-------	$10,516
Clark	62,000	$10,044	732,000	79,788	1,588,000	$193,736	352,713
Elko	3,714,000	601,668	2,478,000	270,102	740,000	90,280	1,078,630
Esmeralda	-------	-------	4,000	436	-------	-------	64,502
Eureka	42,000	6,804	294,000	32,046	7,410,000	904,020	979,956
Humboldt	-------	-------	-------	-------	-------	-------	20,732
Lander	1,074,000	173,988	160,000	17,440	-------	-------	836,948
Lincoln	384,000	62,208	8,246,000	898,814	32,510,000	3,966,220	5,452,435
Lyon	102,000	16,524	-------	-------	-------	-------	107,255
Mineral	12,000	1,944	1,414,000	154,126	278,000	33,916	243,389
Nye	8,000	1,296	154,000	16,786	-------	-------	608,128
Pershing	-------	-------	16,000	1,744	2,000	244	96,042
Storey	-------	-------	6,000	654	-------	-------	231,409
Washoe	12,000	1,944	224,000	24,416	362,000	44,164	87,184
White Pine	91,822,000	14,875,164	608,000	66,272	2,408,000	293,776	16,856,577
Total: 1946	97,232,000	15,751,584	14,350,000	1,564,150	45,298,000	5,526,356	27,026,416
1945	105,190,000	14,200,650	12,550,000	1,079,300	42,914,000	4,935,110	24,186,294

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

MINING INDUSTRY

The 7-percent increase in total tonnage of ores and old tailings sold or treated in Nevada in 1946 compared with 1945 reflects an increase in total dry and siliceous ores (to a large extent used as fluxing ore at base-metal smelters) and an increase in all the base-metal ores except zinc ore. The increased production resulted from higher prices for all metals except gold. It is notable that a greater tonnage of copper ore was treated in 1946 to produce a smaller quantity of copper compared with 1945, which denotes an over-all lower grade of such ore mined.

The connected-bucket dredge of the Manhattan Gold Dredging Co. in the Manhattan district, Nye County, was again the largest producer of placer gold and the third largest producer of gold in the State. Except for this operation and two dragline dredge operations (in Lyon and Lander Counties), Nevada placer mines were limited almost entirely to small-scale hand operations.

ORE CLASSIFICATION

The accompanying table classifying ores sold or treated in Nevada in 1946 shows that 89 percent of the tonnage (including old tailings) was copper ore, 5 percent gold ore and old tailings, 5 percent zinc-lead ore, and the remainder lead ore and old tailings, zinc ore, and silver and gold-silver ore and old tailings.

Details of ore classification are given in the Gold and Silver chapter of this volume.

Ore and old tailings sold or treated in Nevada in 1946, with content in terms of recovered metals

Source	Material sold or treated		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
	Ore (short tons)	Old tailings (short tons)					
Dry and siliceous gold ore	312,179	165	27,614	85,979	2,700	8,000	----------
Dry and siliceous gold-silver ore	6,310	1,838	1,184	93,151	9,500	14,700	----------
Dry and siliceous silver ore	7,241	1,842	175	63,579	17,800	186,700	2,000
Total	325,730	3,845	28,973	242,709	30,000	209,400	2,000
Copper ore	5,102,212	--------	43,260	289,701	[1] 96,959,900	508.000	515,000
Lead ore	11,946	2,522	371	196,518	31,200	3,145,800	19,700
Zinc ore	11,306	--------	103	17,339	89,100	397,200	3,148,600
Zinc-lead ore	268,244	--------	3,187	498,402	121,800	10,089,600	41,612,700
Total lode mines	5,719,438	6,367	75,894	1,244,669	[1] 97,232,000	14,350,000	45,298,000
Placers	----------	--------	14,786	5,982	----------	----------	----------
Total: 1946	5,719,438	6,367	90,680	1,250,651	[1] 97,232,000	14,350,000	45,298,000
1945	5,360,513	14,160	92,265	1,043,380	[2] 105,190,000	12,550,000	42,914,000

[1] Includes 3,229,000 pounds of copper from precipitates.
[2] Includes 4,459,300 pounds of copper from precipitates.

METALLURGIC INDUSTRY

Of the 5,725,805 tons of lode material from Nevada mines sold or treated during 1946, 93 percent went to concentrating mills, 5 percent to amalgamation and cyanidation mills, and 2 percent to smelters; of the total, 6,367 tons (0.11 percent) was old tailings, all cyanided or smelted. Flotation was employed at concentration mills to the virtual exclusion of gravity concentration. Of the gold recovered as bullion, cyanidation supplied 91 percent and amalgamation 9 percent; of the silver recovered as bullion, 98 percent was derived by cyanidation and 2 percent by amalgamation. The tonnage of crude ore and old tailings shipped to smelters decreased 22 percent compared with 1945.

The 600-ton selective-flotation mill operated by the Combined Metals Reduction Co. at Pioche, Lincoln County, treated zinc-lead and zinc ores on a custom basis for several neighboring mines and also milled company zinc-lead ore. The Kennecott Copper Corp. treated all the copper ore produced by the Consolidated Coppermines Corp., on a contract basis, in addition to milling its own ore. The Kennecott Copper Corp. also operated the McGill copper smelter, Nevada's only smelter.

Mine production of metals in Nevada in 1946, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore amalgamated	3,502	1,915	1,397			
Ore and old tailings cyanided	303,293	20,298	71,882			
Concentrates smelted:						
Flotation	233,826	45,111	654,239	87,302,900	7,752,900	40,142,300
Gravity	995	1,017	12,176	44,200	189,300	113,400
Ore and old tailings smelted	115,369	7,553	504,975	6,655,900	6,407,800	5,042,300
Precipitates smelted				3,229,000		
Total lode mines		75,894	1,244,669	97,232,000	14,350,000	45,298,000
Placers		14,786	5,982			
Total: 1946		90,680	1,250,651	97,232,000	14,350,000	45,298,000
1945		92,265	1,043,380	105,190,000	12,550,000	42,914,000

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Nevada in 1946, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated		Recovered in bullion		Concentrates smelted and recovered metal					
	Ore [1] (short tons)	Old tailings (short tons)	Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Churchill	10		3	2						
Clark	2		13	169						
Elko	1		1	1						
Esmeralda	1		22	11						
Humboldt	932		509	324						
Lander	260		125	22						
Lyon	653		281	212						
Nye	298		327	229						
Pershing	976		340	265	5	86	125			
Storey	235		94	95	15	91	367			
Washoe	134		200	67						
Total: 1946	3,502		1,915	1,397	20	177	492			
1945	5,338		1,067	564	23	143	373			

CYANIDATION MILLS

Clark	2,476	1,700	117	8,100						
Humboldt		165	24	60						
Lander	132,185		12,416	1,325						
Lyon	2,400		858	13,500						
Pershing	52,021		1,886	3,804						
Storey	112,346		4,997	45,093	54	15	2,960		6,000	
Total: 1946	301,428	1,865	20,298	71,882	54	15	2,960		6,000	
1945	173,020	520	19,713	4,757						
Grand total:										
1946	304,930	1,865	22,213	73,279	74	192	3,452		6,000	
1945	178,358	520	20,789	5,321	23	143	373			

[1] Figures under "Ore" include both raw ore and concentrates amalgamated or cyanided, but not raw ore concentrated before amalgamation or cyanidation of concentrates.

Mine production of metals from concentrating mills in Nevada in 1946, in terms of recovered metals

BY COUNTIES

	Ore treated (short tons)	Concentrates smelted and recovered metal [1]					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Clark	3,685	488	4	8,676	800	189,300	113,400
Elko	31,214	8,774	186	17,260	3,002,900	73,000	99,700
Eureka	60,486	8,052	39	43,111	42,000	294,000	7,410,000
Lander	76,714	6,707	3,899	58,800	895,300	36,700	
Lincoln	190,108	39,154	3,000	354,420	100	6,747,800	31,992,600
Mineral	2,248	712	14	11,379	2,600	333,400	278,000
Nye	730	43		16,004	1,000	38,000	
Storey	5,000	75	216	2,210			
Washoe	3,305	779	23	10,566	9,000	224,000	362,000
White Pine	4,930,151	169,963	38,555	140,537	83,393,400		
Total: 1946	5,303,641	234,747	45,936	662,963	87,347,100	7,936,200	40,255,700
1945	5,046,971	241,887	52,797	591,024	94,219,800	6,425,600	36,762,300

See footnote at end of table.

Mine production of metals from concentrating mills in Nevada in 1946, in terms of recovered metals—Continued

BY CLASSES OF CONCENTRATES

	Concentrates smelted and recovered metal[1]					
	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	75	216	2,210			
Dry silver	5		1,788			
Copper	185,210	42,604	202,333	87,288,700	36,700	
Lead	9,911	2,072	306,910	13,460	6,810,200	1,020,200
Zinc	39,058	1,040	141,046	44,140	900,000	39,122,100
Zinc-lead	488	4	8,676	800	189,300	113,400
Total 1946	234,747	45,936	662,963	87,347,100	7,936,200	40,255,700

[1] Includes in 1946 concentrates and metals from tungsten ore not included in "Ore treated."

Gross metal content of concentrates produced from ores mined in Nevada in 1946, by classes of concentrates

Classes of concentrates	Concentrates produced (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	96	404	2,718	195		
Dry silver	5		1,788			
Copper	185,210	42,604	202,333	89,454,604	61,100	
Lead	9,964	2,076	309,854	16,325	6,946,069	1,496,181
Zinc	39,058	1,040	141,046	46,393	956,420	40,022,168
Zinc-lead	488	4	8,676	903	192,622	156,404
Total: 1946	234,821	46,128	666,415	89,518,420	8,156,211	41,674,753
1945	241,910	52,940	591,397	98,268,143	6,607,020	37,862,131

Mine production of metals from Nevada concentrates shipped to smelters in 1946 in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Clark	488	4	8,676	800	189,300	113,400
Elko	8,774	186	17,260	3,002,900	73,000	99,700
Eureka	8,052	39	43,111	42,000	294,000	7,410,000
Lander	6,707	3,899	58,800	895,300	36,700	
Lincoln	39,154	3,000	354,420	100	6,747,800	31,992,600
Mineral	712	14	11,379	2,600	333,400	278,000
Nye	43		16,004	1,000	38,000	
Pershing	5	86	125			
Storey	144	322	5,537		6,000	
Washoe	779	23	10,566	9,000	224,000	362,000
White Pine	169,963	38,555	140,537	83,393,400		
Total: 1946	234,821	46,128	666,415	87,347,100	7,942,200	40,255,700
1945	241,910	52,940	591,397	94,219,800	6,425,600	36,762,300

BY CLASS OF CONCENTRATES

Dry gold	96	404	2,718			
Dry silver	5		1,788			
Copper	185,210	42,604	202,333	87,288,700	36,700	
Lead	9,964	2,076	309,854	13,460	6,816,200	1,020,200
Zinc	39,058	1,040	141,046	44,140	900,000	39,122,100
Zinc-lead	488	4	8,676	800	189,300	113,400
Total 1946	234,821	46,128	666,415	87,347,100	7,942,200	40,255,700

Gross metal content of Nevada crude ore and old tailings shipped to smelters in 1946, by classes of material

Class of material	Material treated		Gross metal content				
	Ore (short tons)	Old tailings (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	4,726		5,110	15,151	4,735	4,175	
Dry and Siliceous gold-silver	3,964	138	1,082	86,352	11,345	24,935	
Dry and siliceous silver	7,240	1,842	175	61,772	20,756	211,832	3,512
Copper	65,313		656	87,368	[1] 9,969,674	479,746	711,266
Lead	12,008	2,522	391	207,769	43,491	4,228,043	52,389
Zinc	11,306		103	17,339	103,316	405,372	4,349,357
Zinc-lead	6,310		36	29,224	70,552	1,342,361	1,936,681
Total: 1946	110,867	4,502	7,553	504,975	[1] 10,223,869	6,696,464	7,053,205
1945	135,184	13,640	8,976	442,851	[2] 11,468,165	6,390,817	8,500,263

[1] Includes 3,308,405 pounds of copper from precipitates.
[2] Includes 4,652,842 pounds of copper from precipitates.

Mine production of metals from Nevada crude ore and old tailings shipped to smelters in 1946, in terms of recovered metals

BY COUNTIES

	Material treated		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
	Ore (short tons)	Old tailings (short tons)					
Churchill	267		184	3,024		14,000	
Clark	5,557		834	26,700	61,200	542,700	1,474,600
Elko	10,269	2,522	82	115,369	711,100	2,405,000	640,300
Esmeralda	1,697		1,665	6,073		4,000	
Eureka	4		1	317			
Humboldt	38		44	19			
Lander	2,892		186	6,732	178,700	423,300	
Lincoln	12,487	138	451	146,085	383,900	1,198,200	517,400
Lyon	1,019		45	380	102,000		
Mineral	1,113	1,842	175	45,477	9,400	1,080,600	
Nye	2,921		942	83,175	7,000	116,000	
Pershing	201		1	2,411		16,000	2,000
Storey	1		6	129			
Washoe	4		5	110	3,000		
White Pine	72,397		2,932	68,974	[1] 8,428,600	608,000	2,408,000
Total: 1946	110,867	4,502	7,553	504,975	[1] 9,884,900	6,407,800	5,042,300
1945	135,184	13,640	8,976	442,851	[2] 10,970,200	6,124,400	6,151,700

BY CLASSES OF MATERIAL

Dry and siliceous gold	4,726		5,110	15,151	2,700	2,000	
Dry and siliceous gold-silver	3,964	138	1,082	86,352	9,500	14,700	
Dry and siliceous silver	7,240	1,842	175	61,772	17,800	185,700	2,000
Copper	65,313		656	87,368	[1] 9,671,200	471,300	515,000
Lead	12,008	2,522	391	207,769	32,500	4,017,200	8,600
Zinc	11,306		103	17,339	89,100	398,200	3,148,600
Zinc-lead	6,310		36	29,224	62,100	1,318,700	1,368,100
Total 1946	110,867	4,502	7,553	504,975	[1] 9,884,900	6,407,800	5,042,300

[1] Includes 3,229,000 pounds of copper from precipitates.
[2] Includes 4,459,300 pounds of copper from precipitates.

REVIEW BY COUNTIES AND DISTRICTS

CHURCHILL COUNTY

Eastgate District.—William H. Schweis shipped gold ore to a smelter from the Gold Ledge mine during 1946. Fred F. Erb worked the Gold Trail & Lucky group during the year and recovered gold by amalgamation. Ed Tavernia shipped 13 tons of gold-silver ore to a smelter from the North Star mine and recovered 2 ounces of gold and 318 ounces of silver.

Holy Cross District.—A small quantity of gold-silver ore from the Good Hope mine was shipped to a smelter by Louis DeVetsera, and J. J. Martin shipped 6 tons of silver ore to a smelter during 1946.

CLARK COUNTY

Eldorado Canyon District.—The Patimac Metals Co. operated the Eldorado, Rover, Crown, and Rambler groups of claims in 1946.

Searchlight District.—Lessees shipped gold ore to smelters from the Blossom mine during 1946. The M & M Mines, Inc., operated the Quartette mine during July and August 1946; gold-silver ore containing some copper and lead was shipped to a smelter.

Yellow Pine (Goodsprings) District.—The Argentena Consolidated Mining Co. worked the Argentena mine throughout 1946; 989 tons of zinc ore containing 10 ounces of gold, 3,663 ounces of silver, 1,702 pounds of copper, 53,110 pounds of lead, and 418,243 pounds of zinc were shipped to a smelter. R. F. Carlson operated the Clementina mine from April 1 through December 20, 1946, and shipped 22 tons of gold ore to a smelter. William T. Frazer worked the Hoosier mine during the first 6 months of 1946 and shipped zinc-lead ore to a smelter. The Diamond Gold Mining Co. operated the Mountain Top mine from February 15 to March 25, 1946, shipping 45 tons of zinc-lead ore containing 30 ounces of silver, 5,536 pounds of lead, and 15,006 pounds of zinc to a smelter. H. K. Thurber shipped 42 tons of copper ore to a smelter from the Ninety-Nine mine during the last 2 months of 1946; the ore contained 179 ounces of silver, 10,291 pounds of copper, and 209 pounds of lead. Hamilton and Jacobson operated the Pilgrim, Root Zinc, and Sultan mines during 1946. Zinc-lead ore from the Pilgrim mine (965 tons containing 9 ounces of gold, 2,934 ounces of silver, 19,029 pounds of copper, 115,571 pounds of lead, and 372,492 pounds of zinc) was shipped to a smelter. Zinc ore from the Root Zinc mine (773 tons containing 6 ounces of gold, 1,763 ounces of silver, 24,902 pounds of copper, 60,977 pounds of lead, and 292,107 pounds of zinc) was shipped also to a smelter. From the Sultan mine 3,685 tons of zinc-lead ore were milled in a 75-ton gravity concentration plant to produce 488 tons of zinc-lead concentrates containing 4 ounces of gold, 8,676 ounces of silver, 903 pounds of copper, 192,622 pounds of lead, and 156,404 pounds of zinc; in addition, 1,295 tons of zinc-lead ore containing 7 ounces of gold, 10,716 ounces of silver, 2,860 pounds of copper, 185,512 pounds of lead, and 570,505 pounds of zinc were shipped to a smelter. The Coronado Copper & Zinc Co. worked the Yellow Pine mine from January through August 1946 and shipped zinc ore to a smelter.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1946, by counties and districts, in terms of recovered metals[1]

County and district[1]	Mines producing[2]		Ore and old tailings (short tons)	Gold (fine ounces)			Silver (lode and placer)[3] (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total					
Churchill County:											
Eastgate	4		211	177		177	1,620		14,000		$9,030
Holy Cross	3		66	10		10	1,406				1,486
Clark County:											
Eldorado Canyon	1		4,382	118		118	8,203				10,758
Searchlight	5		393	785		785	5,937	6,000	4,000		33,680
Yellow Pine (Goodsprings)	9		8,645	65		65	29,505	56,000	728,000	1,588,000	308,275
Elko County:											
Contact (Salmon River)	4		1,048	10		10	1,068	55,600	40,600		14,645
Cortez	1		325	29		29	5,852	500	20,000	24,400	10,981
Delano	2		3,171	22		22	75,932	11,700	1,037,300	7,000	177,938
Island Mountain	1		1	1		1	1				36
Loray	1		2,522				16,141	6,000	307,200		47,499
Merrimac	1		825	7		7	6,521	2,400	52,900	72,800	20,551
Railroad	1		63				307	2,100	100	2,500	904
Ruby Valley	1		51				83		13,600	10,200	2,793
Spruce Mountain	4		4,192	23		23	21,204	42,900	1,006,300	623,100	210,593
Esmeralda County:											
Goldfield	6		221	384		384	635		2,000		14,171
Gold Mountain (Divide)	2		1,391	1,126		1,126	5,077				43,512
Hornsilver	1		60	129		129	341		2,000		5,009
Silver Peak	1		26	48		48	31				1,705
Sylvania		1			3	3					105
Eureka County:											
Eureka	2		60,490	40		40	43,428	42,000	294,000	7,410,000	979,360
Lynn		2			17	17	1				596
Humboldt County:											
Awakening	3		824	491		491	324				17,447
Barrett Springs	3		229	47		47	69				1,701
Paradise Valley	2	1	81	22	6	28	6				985
Potosi	1		1	17		17	5				599
Lander County:											
Battle Mountain	6	3	79,450	3,949	273	4,222	61,339	1,074,000	90,000		381,130
Bullion	2		132,233	12,473		12,473	1,344				437,641
Hilltop	1		6	76		76	27				2,682
New Pass	2		352	126		126	4,187		70,000		15,423
Reese River	1		10	2		2	3				72

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1946, by counties and districts, in terms of recovered metals[1]—Con.

County and district[1]	Mines producing[2]		Ore and old tailings (short tons)	Gold (fine ounces)			Silver (lode and placer)[3] (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer		Lode	Placer	Total					
Lincoln County:											
Chief (Caliente)	1		36	25		25	177				$1,018
Comet	2		1,683	42		42	9,516		70,900	455,900	72,507
Ferguson	1		126	160		160	164				5,733
Groom	2		3,107	11		11	8,530	2,900	717,400	11,100	87,298
Jack Rabbit	1		6,263	37		37	78,760	377,200	471,000	515,000	240,208
Pioche	12		191,518	3,176		3,176	403,358	3,900	6,986,700	31,528,000	5,045,671
Lyon County:											
Silver City	11	2	3,053	1,139	1,070	2,209	14,275				88,849
Talapoosa	1		52	30		30	120				1,147
Yerington	3		967	15		15	260	102,000			17,259
Mineral County:											
Bell	1		3,094	34		34	39,028	5,000	1,267,000	278,000	205,554
Columbus (Candelaria)	1		1,842	61		61	13,915	4,000	130,000		28,196
Regent	(4)	4	(4)	(4)	21	[5] 21	[5] 10				[5] 743
Santa Fe	2		178	12		12	3,642	3,000	17,000		5,702
Silver Star	1		54	55		55	62				1,975
Nye County:											
Bellehelen	1		30	12		12	693				980
Bullfrog	2		3	1		1	9				42
Golden Arrow	1		6	3		3	8				111
Johnnie	1		25	19		19	11				674
Manhattan	3	5	271	307	13,171	13,478	5,545				476,210
Morey	1		1				22				18
Quartz Mountain	1		517	13		13	5,573	4,300	85,000		14,920
Reveille	1		71	1		1	607		31,000		3,904
San Antone	1		24	2		2	439				425
Tonopah	8		2,268	911		911	75,840	2,700			93,601
Union	2		733				16,013	1,000	38,000		17,243
Pershing County:											
Antelope (Majuba)		(6)			10	10	3				352
Echo (Rye Patch)	1		52,021	1,886		1,886	3,804				69,084
Humboldt (Imlay)	1	3	39		15	15	846		4,000		1,645
Rochester	4	6	217	10	56	66	1,533		12,000	2,000	5,141
Rosebud		4			140	140	15				4,912
Seven Troughs	4		892	408		408	384				14,590
Sierra	1		29	9		9	4				318
Storey County:											
Comstock	6		117,582	5,419		5,419	50,854		6,000		231,409

Washoe County:											
Galena	1		3,305	23		23	10,566	9,000	224,000	362,000	79,380
White Horse (Olinghouse)	6		138	205		205	177	3,000			7,804
White Pine County:											
Aurum	6		8,587	229		229	14,932	264,200	128,200	1,550,000	265,954
Cherry Creek	2		3	3		3	1,790				1,551
Eagle	1		38	3		3	585		12,000		1,886
Granite (Steptoe)	2		66	136		136	45		2,400		5,058
Osceola	[4]	1	[4]	[4]	1	[5] 1	[4]				[5] 35
Robinson (Ely)	13		4,984,701	39,234		39,234	151,548	91,554,400	166,000	858,000	16,450,224
Shoshone	1		3				74				60
Taylor	3		3,284	37		37	12,892	500	10,600		12,948
White Pine (Hamilton)	5		4,174	67		67	27,061	2,900	288,800		56,159
Other districts [7]	4	1	33,535	1,982	3	1,985	6,314	3,592,800			656,611
Total Nevada	193	33	5,725,805	75,894	14,786	90,680	1,250,651	97,232,000	14,350,000	45,298,000	27,026,416

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures: other producing districts listed in footnote 7 and their output included under "Other districts."

[2] Excludes itinerant prospectors, snipers, high graders, and others who gave no evidence of legal right to property.

[3] Source of total silver as follows: 1,244,669 ounces from lode mines and 5,982 from placers.

[4] Included under "Other districts."

[5] Exclusive of lode output, which is included in "Other districts."

[6] Output from property not classed as a mine.

[7] Includes following districts: Eastgate in Churchill County; Cope in Elko County; East Walker and Regents (lode) in Mineral County; and Osceola in White Pine County.

ELKO COUNTY

Contact (Salmon River) District.—The Marshall Mining Co. worked the Allen and Delano claims during 5 months in 1946 and shipped 975 tons of copper ore containing 10 ounces of gold, 943 ounces of silver, and 56,716 pounds of copper to a smelter. Lessees worked the Galena King mine during 1946, shipping lead ore to a smelter.

Cope (Mountain City) District.—The Mountain City Copper Co. (the third largest copper producer in Nevada) operated throughout 1946; most of the ore was treated in the company 400-ton flotation mill, but some high-grade copper ore was shipped for direct smelting.

Cortez District.—The McCarthy Mining Co. operated the Mill Canyon mine throughout 1946; 325 tons of zinc-lead ore were shipped to a concentrator-smelter.

Delano District.—McFarland & Hullinger worked the Cleveland mine during 1946, shipping lead ore to a smelter. Aaron Bracken shipped lead ore from the Gold Note mine to a smelter.

Loray District.—During 1946, L. D. Foreman and Charles E. Roberts shipped old tailings containing silver, lead, and a small quantity of copper to a smelter from the Maybelle mine.

Merrimac District.—The Rip Van Winkle Consolidated Mining Co. operated the Rip Van Winkle mine from May to December 1946, shipping 825 tons of zinc-lead ore containing 8 ounces of gold, 7,335 ounces of silver, 3,746 pounds of copper, 59,129 pounds of lead, and 93,936 pounds of zinc to a concentrator-smelter for treatment.

Railroad District.—Byrns Basin Mines, Inc., worked the Gray Eagle mine, shipping copper ore to a smelter and zinc-lead ore to a concentrator-smelter for treatment.

Ruby Valley District.—Lambert & Associates operated the Michigan group and shipped a small quantity of zinc-lead ore to a smelter.

Spruce Mountain District.—Eugene Parker shipped 28 tons of lead ore containing 209 ounces of silver, 205 pounds of copper, and 6,739 pounds of lead to a smelter from the Humbug mine in 1946. The Missouri Monarch Consolidated Mines Co. and R. J. Birch worked the Monarch mine during 1946, shipping silver ore and lead ore to a smelter. The Nevada Lead Zinc Co. operated the Nevada Lead mine during 1946, shipping zinc-lead ore to a smelter. Edgar O. Gibson shipped lead ore from the Spruce Standard mine during a short period of operation in the last quarter of 1946.

ESMERALDA COUNTY

Goldfield District.—The Combination Fraction Mining Co. worked the Combination Fraction mine throughout 1946; 51 tons of gold ore containing 103 ounces of gold and 14 ounces of silver were shipped to a smelter. Pius Kaelin worked the Possibility mine, shipping a small tonnage of lead ore to a smelter. Lessees operated the St. Ives, Florence, and Black Butte claims of the Goldfield Deep Mines Co. of Nevada intermittently during 1946; 107 tons of gold ore containing 216 ounces of gold and 78 ounces of silver were shipped to a smelter. The Goldfield Consolidated Mines Co. worked the mine of the same name during 1946 and shipped 51 tons of gold ore containing 63 ounces of gold and 30 ounces of silver to a smelter.

Gold Mountain (Divide) District.—Lessees working the Tonopah Divide mine shipped 1,383 tons of gold ore containing 1,123 ounces of gold and 5,046 ounces of silver to a smelter during 1946. N. L. Brown operated the Gila Monster mine for 6 months in 1946, shipping 8 tons of gold ore to a smelter.

Hornsilver District.—Earl B. Mack operated the Gold Crest (Ohio) mine and shipped gold ore to a smelter; in addition, a small quantity of gold and silver was recovered by amalgamation.

Silver Peak District.—Roy Cleary and Frank Scott recovered 48 ounces of gold and 31 ounces of silver from 26 tons of gold ore shipped to a smelter from the Coyote mine during the latter part of 1946.

EUREKA COUNTY

Eureka District.—The Callahan Zinc-Lead Co. worked the Mount Hope mine throughout 1946, treating 60,486 tons of zinc-lead ore in the company 250-ton flotation mill. Two hundred and five tons of lead concentrate (containing 10 ounces of gold, 25,845 ounces of silver, 2,224 pounds of copper, 246,762 pounds of lead, and 14,580 pounds of zinc) and 7,847 tons of zinc concentrate (containing 29 ounces of gold, 17,266 ounces of silver, 41,769 pounds of copper, 58,951 pounds of lead, and 7,549,469 pounds of zinc) were shipped to smelters. Santos Jayo and Wallace R. Jurey shipped 4 tons of silver ore containing 1 ounce of gold and 317 ounces of silver from the Gates Bertrand open-pit mine to a smelter.

HUMBOLDT COUNTY

Awakening District.—The Awakening Syndicate did some rehabilitation work at the Alabama mine in 1946 and shipped 37 tons of gold ore to a smelter. The Austin Bros. Gold Mining Co. treated gold ore from the Jumbo mine by amalgamation during 1946. Jay S. Jones worked the May Day mine intermittently during 1946 and treated gold ore by amalgamation.

Barrett Springs District.—Jeff Rice worked the King Gold No. 2 and Stormy Weather mines in 1946; gold ore from each mine was treated by amalgamation. M. J. Smith treated the Ten Mile tailings dump by cyanidation during irregular periods of operation in 1946.

Paradise Valley District.—Wesley Lane reopened the El Paso mine during the last quarter of 1946 after a long period of idleness; 75 tons of gold ore containing 13 ounces of gold and 3 ounces of silver were treated by amalgamation in a newly installed 25-ton mill. Arnold Scossa treated a few tons of gold ore by amalgamation at the Yellow Metal mine.

Potosi District.—Getchell Mines, Inc., made some test runs of ore from the Getchell mine and from less than a ton of material shipped to two smelters recovered 17 ounces of gold and 5 ounces of silver.

LANDER COUNTY

Battle Mountain District.—The Hi-Bar Co. conducted placer operations in Iron Canyon, and the Natomas Co. operated a dragline dredge at Greenan Placers in 1946. Lessees operated the Copper Canyon Mining Co. Copper Basin property during 1946; although most of

the copper ore was shipped to a smelter, some ore was treated by flotation in the Copper Canyon Mining Co. mill. The Copper Canyon mine and 350-ton flotation mill were operated by the Copper Canyon Mining Co. throughout 1946; copper concentrate was shipped to a smelter. Claude A. Post, lessee, worked the Gold Butte mine for 2 months in 1946 and shipped 52 tons of gold-silver ore (containing 7 ounces of gold, 540 ounces of silver, 236 pounds of copper, and 5,182 pounds of lead) to a smelter. Nelson & Riech, lessees, operated the Silver Chief group from March 1 to June 10, 1946, shipping 41 tons of gold-silver ore containing 5 ounces of gold, 184 ounces of silver, 259 pounds of copper, and 5,184 pounds of lead to a smelter. The same partnership worked the Nevada group from August 26 through the remainder of the year, shipping 189 tons of lead ore containing 16 ounces of gold, 1,536 ounces of silver, 282 pounds of copper, and 48,935 pounds of lead to a smelter.

Bullion District.—The Goldacres mine was operated throughout 1946, for the first 9 months by Willow Creek Mines, Inc., and the last 3 months by Consolidated Goldacres Co., owner of the property. Ore mined by open-pit method was treated by cyanidation. O'Leary & Kinsella shipped gold ore to a smelter from the Gold Quartz mine during the first part of 1946.

New Pass District.—The Thomas W. mine was operated almost continuously throughout 1946 by the Reorganized Silver King Divide Mining Co.; gold ore was treated by amalgamation, and in addition lead ore was shipped for direct smelting.

LINCOLN COUNTY

Chief (Caliente) District.—Lloyd Hoskins, lessee, shipped gold ore from the Caliente-Cobalt mine to a smelter.

Comet District.—Comet Mines, Inc., worked the Comet mine during 1946 and shipped zinc-lead ore to a custom flotation mill for treatment. Joan Valente shipped a small tonnage of lead ore from the Wood Butcher mine to a smelter.

Ferguson District.—During 1946 lessees shipped gold ore to a smelter from the Delamar mine.

Groom District.—The International Mining Corp. and Dan Sheahan worked the Groom mine during the first 6 months of 1946, and during the latter half of the year Dan Sheahan operated the property. Lead ore (3,012 tons containing 11 ounces of gold, 7,786 ounces of silver, 3,498 pounds of copper, 698,706 pounds of lead, and 40,402 pounds of zinc) was shipped to a smelter; in addition, 54 tons of lead ore containing 399 ounces of silver, 181 pounds of copper, 25,276 pounds of lead, and 24,934 pounds of zinc were shipped to a concentrator-smelter for treatment.

Jack Rabbit District.—The Bristol Silver Mines Co. operated the Bristol Silver mine throughout 1946; 6,263 tons of copper ore containing 37 ounces of gold, 78,760 ounces of silver, 443,763 pounds of copper, 479,159 pounds of lead, and 711,266 pounds of zinc were shipped to a smelter.

Pioche District.—The Combined Metals Reduction Co. operated its enlarged 600-ton flotation mill on company and custom ore throughout

1946. Company ore was derived from the Abe Lincoln, Pioche No. 2, and Amalgamated Pioche properties. This ore, with custom ore from the Raymond Ely West Mining Co. property, was hoisted through the Castleton shaft. Additional custom zinc-lead ore for the mill was derived from the Ely Valley and Prince mines. The mill products were lead concentrate and zinc concentrate, which were shipped to smelters. The Salt Lake-Pioche Mining Co. operated the Apex and Financier mines throughout 1946. Lead ore from the Apex mine (454 tons containing 36 ounces of gold, 11,764 ounces of silver, 268 pounds of copper, and 84,805 pounds of lead) was shipped to a smelter. Also shipped to a smelter, 1,579 tons of lead ore from the Financier mine (leased to O. G. Jarvis) contained 120 ounces of gold, 41,205 ounces of silver, 663 pounds of copper, and 317,886 pounds of lead. Free Bros. operated the Black Prince mine in 1946, shipping gold-silver ore to a smelter; it also shipped old tailings from the Dry Valley mine and recovered gold, silver, and some lead. Hall Bros., under a lease from Amalgamated Pioche Mines, shipped several carlots of gold-silver ore from the old Raymond Ely dump to a smelter.

LYON COUNTY

Silver City District.—The Grafe Dayton Dredging Co. operated a large dragline excavator and floating washing plant at the north edge of Dayton during the last quarter of 1946. W. M. Donovan operated his custom cyanide mill in Silver City during 1946 on ores from his own mines—the Silver Hill and the Hartford (Storey County). A number of small mines in the district were active during 1946; gold ore from the following properties was treated by amalgamation: Buckeye Extension (Leo K. Johnson), Dayton (Willis F. Wilson), Gamble and M. C. Nos. 1–2–3 (J. A. Cushman), Montezuma (Panos & McGuire), Haywood and Oest (Harry Bennett), Silver City (Nevada Mining Exchange, Inc.), Valentine (Serfeno Pedroli), and Wonder Extension (A. R. Dickson et al.).

Talapoosa District.—F. J. De Longchamps operated the Talapoosa mine from January through April 1946 and shipped gold ore to a smelter.

Yerington District.—Ed Parr shipped copper ore to a smelter from the Malachite mine during 1946 and also worked the Mason Valley mine, as did J. B. Bookman, Anton Lilja, and Al Matt; copper ore was shipped to a smelter. Anton Lilja worked the Northern Lights mine during the latter part of 1946, shipping copper ore to a smelter.

MINERAL COUNTY

Bell District.—The Simon Lead mine was worked extensively during 1946 by the B. B. S. Mining Corp. and Wilson & Simpson; zinc-lead ore was shipped to a concentrator-smelter for treatment, and a smaller tonnage of lead ore was shipped for direct smelting.

Columbus (Candelaria) District.—Charles R. Hammock shipped old tailings containing silver and lead from the Columbus mine to a smelter during 1946.

Santa Fe District.—Olsen, Cram & Taylor worked the Commodore mine during 1946, shipping silver ore to smelters. The Lime Point

mine was operated for a short period during the year by Charles R. Hammock; lead ore was shipped to a smelter.

Silver Star District.—Layton & Brasher, lessees, shipped 54 tons of gold ore containing 55 ounces of gold and 62 ounces of silver to a smelter from the Sunshine mine during 1946.

NYE COUNTY

Bellehelen District.—Western Gold Co. and Neighbors & Terrell shipped gold-silver ore from the dumps of the Clifford mine to a smelter during 1946.

Manhattan District.—The Manhattan Gold Dredging Co. (largest producer of placer gold in the State) operated throughout 1946 its electric connected-bucket dredge equipped with 108 9½-cubic-foot buckets. The Manhattan Gold Mines Co. operated the Manhattan mine during 1946; gold ore was treated by amalgamation.

Quartz Mountain District.—Obie LeFavor, lessee, worked the San Rafael mine throughout 1946; 517 tons of lead ore containing 13 ounces of gold, 5,573 ounces of silver, 4,947 pounds of copper, and 86,799 pounds of lead were shipped to a smelter.

Reveille District.—O. J. Belleville, lessee, worked the Reveille mine dumps intermittently during 1946; 71 tons of material shipped to a smelter contained 1 ounce of gold, 607 ounces of silver, 138 pounds of copper, and 31,794 pounds of lead.

San Antone District.—W. E. King and H. J. Kniefel worked the Burbank No. 1 mine during 1946, shipping 24 tons of silver ore containing 2 ounces of gold and 439 ounces of silver to a smelter.

Tonopah District.—Gold-silver ore mined by a lessee at the Jim Butler mine (220 tons containing 114 ounces of gold and 9,667 ounces of silver) was shipped to smelters. Several separate groups of lessees worked the property of the Tonopah Mining Co. of Nevada during 1946 and shipped 1,892 tons of gold-silver ore containing 763 ounces of gold and 63,703 ounces of silver to smelters.

Union District.—Alexander and Brooklyn Mines, Inc., operated the Alexander mine during 1946; lead ore was treated in the company 50-ton flotation mill, and the lead concentrate produced was shipped to a smelter.

PERSHING COUNTY

Echo (Rye Patch) District.—The Standard Cyaniding Co. operated the Standard mine, 18 miles south of Imlay, from September 16 to December 31, 1946; 52,021 tons of gold ore were cyanided to recover 1,886 ounces of gold and 3,804 ounces of silver.

Rochester District.—Silver ore was shipped to a smelter from the Bonanza King mine by V. D. Bradley and from the Olive mine by Fred Neff during 1946.

Seven Troughs District.—G. P. Williams worked the Portland mine during 1946; gold ore was treated in an amalgamation-concentration mill.

Sierra District.—Clarence Basso worked the Auburn mine from April 16 to November 6, 1946, and recovered 9 ounces of gold and 4 ounces of silver from 29 tons of ore treated by amalgamation.

STOREY COUNTY

Comstock District.—W. M. Donovan operated the Hartford mine during 1946 and treated the ore by cyanidation at his mill at Silver City. The South Comstock Gold Mines, Inc., operated the Brunswick mine for a short period in 1946; gold ore was treated in an amalgamation-concentration mill, the concentrates being shipped to a smelter. The Consolidated Virginia Mining Co. operated the Consolidated Virginia mine for 2 months in 1946; 5,000 tons of gold ore were treated in a 100-ton flotation mill to produce 75 tons of concentrate (containing 216 ounces of gold, 2,210 ounces of silver, and 175 pounds of copper), which was shipped to a smelter. The Dayton Consolidated Mines Co. operated the company custom cyanide mill at Silver City, Lyon County, during the first part of 1946 treating gold ore from the Keystone mine and various smaller shippers. The Overman open-pit mine was operated by the Consolidated Chollar Gould & Savage Mining Co. from April 10 through December 31, 1946; 111,078 tons of gold ore were treated in the company 500-ton cyanide plant to recover 4,558 ounces of gold and 43,688 ounces of silver.

WASHOE COUNTY

Galena District.—The Union Lead Mining & Smelting Co. shipped milling-grade zinc-lead ore to custom concentrators for selective flotation.

WHITE PINE COUNTY

Aurum (Silver Mountain) District.—The Grand Deposit Mining Co. operated the Grand Deposit and Kansas mines throughout 1946. From the Grand Deposit mine 5,493 tons of zinc ore (containing 25 ounces of gold, 5,084 ounces of silver, 62,811 pounds of copper, 104,903 pounds of lead, and 2,140,819 pounds of zinc) and 44 tons of silver ore (containing 1 ounce of gold, 288 ounces of silver, 1,544 pounds of copper, and 4,059 pounds of lead) were shipped to smelters for treatment. From the Kansas mine 2,410 tons of copper ore containing 25 ounces of gold, 3,430 ounces of silver, and 205,118 pounds of copper were shipped for direct smelting.

Osceola District.—The Gilded Age Mining Co. operated the Gilded Age mine throughout 1946 and shipped gold ore to a smelter.

Robinson (Ely) District.—The Nevada Mines Division of the Kennecott Copper Corp. worked the Copper Flat pit and the Ruth mine throughout 1946. This corporation also operated the McGill flotation concentrator and the McGill copper smelter—both at McGill—where the product from its mines and that of the Consolidated Coppermines Corp. were treated. Kennecott, the largest privately financed industrial organization in Nevada, produced over half the total copper for the State and was the leading producer of gold in Nevada. The Consolidated Coppermines Corp., second largest copper and gold producer in the State in 1946, was active throughout the year. Korgan-Piscovich worked the Calumet group during 1946 and shipped 679 tons of zinc ore containing 3 ounces of gold, 473 ounces of silver, 2,925 pounds of copper, 5,612 pounds of lead, and

297,527 pounds of zinc to a smelter. Sam Robinson shipped zinc ore to a smelter from the Columbia mine. Drollinger & Steele worked the Golden Revenue mine intermittently in 1946 and shipped 441 tons of gold-silver ore containing 62 ounces of gold, and 1,508 ounces of silver to a smelter. Benson Bros. and Johnson & Mays shipped 42 tons of lead ore (containing 3 ounces of gold, 485 ounces of silver, 146 pounds of copper, and 31,840 pounds of lead) to a smelter from the Golden Rod mine. Lessees worked the Sunbeam claim of the Kennecott Copper Corp. during the latter half of 1946; 71 tons of gold-silver ore containing 26 ounces of gold and 2,501 ounces of silver were shipped. O. V. Siegle and Roy Linsea worked the Veteran mine during the last quarter of 1946 and shipped gold ore and copper ore to a smelter.

Taylor District.—Ramsey, Bower & Gubler worked the Capital Hills mine from April 1 to December 15, 1946, and shipped silver ore to a smelter. The Goodman mine was operated by the Nevada Sunshine Silver Mines and A. E. Potash, lessees, during 1946; a substantial tonnage of silver ore and lead ore was shipped to smelters.

White Pine District.—E. R. Woolley shipped lead ore to a smelter from the Dog Star mine and the Young Treasure dump during 1946. Hall Bros. shipped a substantial tonnage of silver ore to a smelter from the Treasure Hill mine during 1946.

New Mexico
Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By S. A. GUSTAVSON

GENERAL SUMMARY

THE quantities of gold, silver, copper, lead, and zinc produced by New Mexico mines in 1946 compared with 1945 were less in each instance, but the total value of the five metals was slightly greater in 1946. Factors contributing to the decrease in production were shortage of skilled labor, uncertainty of the continuation of the Premium Price Plan, labor strikes or unrest at major producing mines and smelters, and, to some extent, a lower average grade of ore mined (considerable quantities of low-grade ore from development were treated). Also, difficulties in obtaining equipment and higher cost of both labor and equipment were deterrents to the reopening of mines, especially those most dependent upon gold as a source of revenue.

Production (in terms of recovered metals) in 1946 was 4,009 fine ounces of gold, 338,000 fine ounces of silver, 100,382,000 pounds of copper, 9,798,000 pounds of lead, and 72,206,000 pounds of zinc, compared with 5,604 ounces of gold, 465,127 ounces of silver, 113,142,000 pounds of copper, 15,324,000 pounds of lead, and 80,590,000 pounds of zinc in 1945.

The total gross value of gold, silver, copper, lead, and zinc produced in 1946, calculated at the average prices shown in the following table, was $26,552,417, compared with $26,386,781 in 1945, and included gold valued at $140,315, silver $273,104, copper $16,261,884, lead $1,067,-

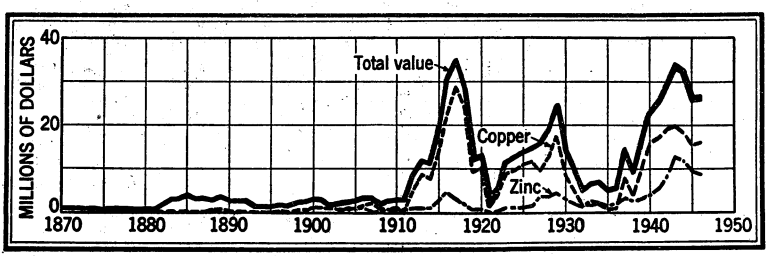

FIGURE 1.—Value of mine production of copper and zinc and total value of gold, silver, copper, lead, and zinc in New Mexico, 1870–1946. The value of gold, silver, and lead produced annually has been relatively small.

982, and zinc $8,809,132. Of the 1945 total, $196,140 was in gold, $330,757 in silver, $15,274,170 in copper, $1,317,864 in lead, and $9,267,850 in zinc. Thus the output of all five metals decreased in both quantity and value except copper, which, however, increased only in value.

A comparison of mine production in 1946 with 1945 and former years shows: Gold production decreased 28 percent from 1945 and was the lowest since 1876; silver decreased 27 percent and was the lowest since 1904; copper decreased 11 percent but was greater than any year prior to 1940 except 1917; lead decreased 36 percent but was greater than the war years 1941 and 1942; and zinc decreased 10 percent but was still the highest of any year prior to 1941—the peak of 119,048,000 pounds was reached in 1943.

Of the 11 counties producing in New Mexico in 1946 Grant County was by far the largest contributor to the metal output, accounting for 93 percent of the State total value and ranking first in output of each of the five metals. Socorro County produced these five metals valued at 5 percent and all other counties 2 percent of the State total.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices:

Prices of gold, silver, copper, lead, and zinc, 1942–46

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1942	$35.00	$0.711+	$0.121	$0.067	$0.093
1943	35.00	.711+	.130	.075	.108
1944	35.00	.711+	.135	.080	.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+ ($20.671835) per fine ounce.
[2] Treasury buying price for newly mined silver, 1942 to June 30, 1946: $0.71111111; July 1, 1946 to Dec. 31, 1946: $0.905.
[3] Yearly average weighted price of all grades of primary metal sold by producers; price includes bonus payments by Office of Metals Reserve for overquota production.

Mine production of gold, silver, copper, lead, and zinc in New Mexico, 1946, by months, in terms of recovered metals

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds	Zinc (pounds)
January	370	26,500	9,068,000	1,100,000	5,526,000
February	370	28,400	8,144,000	1,030,000	5,858,000
March	273	22,600	8,734,000	748,000	5,266,000
April	413	24,850	8,634,000	756,000	4,940,000
May	487	21,200	7,872,000	668,000	5,308,000
June	290	26,690	8,046,000	760,000	5,068,000
July	220	28,680	8,892,000	892,000	6,404,000
August	343	24,750	8,276,000	712,000	7,006,000
September	352	29,730	8,170,000	672,000	6,260,000
October	300	37,100	8,390,000	880,000	6,760,000
November	300	34,000	8,000,000	800,000	6,950,000
December	291	33,500	8,156,000	780,000	6,860,000
Total: 1946	4,009	338,000	100,382,000	9,798,000	72,206,000
1945	5,604	465,127	113,142,000	15,324,000	80,590,000

The following table shows the number of mines in New Mexico producing gold, silver, copper, lead, and zinc and their annual output of ore and metals from 1942 to 1946, as well as the total production from 1848 to 1946. The report of this series for 1929 (chapter of Mineral Resources of the United States, 1929, pt. 1, pp. 729–759) gives the yearly production of each important metal-producing district in New Mexico from 1904 to 1929, inclusive. Subsequent records, year by year, may be found in annual issues of Mineral Resources and Minerals Yearbook.

Mine production of gold, silver, copper, lead, and zinc in New Mexico, 1942–46, and total, 1848–1946, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1942	78	48	8,221,512	11,961	$418,635	676,170	$480,832
1943	64	16	8,329,043	5,563	194,705	463,583	329,659
1944	55	3	7,943,846	6,918	242,130	535,275	380,640
1945	46	4	6,843,327	5,604	196,140	465,127	330,757
1946	50	4	6,594,890	4,009	140,315	338,000	273,104
1848–1946			(1)	2,182,835	49,733,418	67,754,731	52,945,198

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1942	160,200,000	$19,384,200	9,216,000	$617,472	92,922,000	$8,641,746	$29,542,885
1943	152,326,000	19,802,380	11,446,000	858,450	119,048,000	12,857,184	34,042,378
1944	139,460,000	18,827,100	14,530,000	1,162,400	101,454,000	11,565,756	32,178,026
1945	113,142,000	15,274,170	15,324,000	1,317,864	80,590,000	9,267,850	26,386,781
1946	100,382,000	16,261,884	9,798,000	1,067,982	72,206,000	8,809,132	26,552,417
1848–1946	[2] 1,350,199	398,428,717	[2] 274,841	28,555,899	[2] 844,940	126,028,192	655,691,424

[1] Figure not available.
[2] Short tons.

Gold and silver produced at placer mines in New Mexico, 1942–46, in terms of recovered metals

Year	Gold		Silver		Total value	Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value			Fine ounces	Value	Fine ounces	Value	
1942	1,247	$43,645	135	$96	$43,741	1945	15	$525	7	$5	$530
1943	92	3,220	25	18	3,238	1946	10	350	2	2	352
1944	8	280			280						

Gold.—During 1946, the first full year after revocation of War Production Board Limitation Order L–208 (effective July 1, 1945), production of gold from the State decreased 28 percent from 1945. This decrease in gold output can be attributed to the suspension of operations from June to November by the Exploration Syndicate, Inc., at the Carlisle group of mines and the loss of about 3 months' production because of a labor strike at the American Smelting & Refining Co. Hanover unit; moreover, high labor and material costs

hampered the reopening of gold mines. Mine production of recovered gold in New Mexico decreased from 5,604 fine ounces in 1945 to 4,009 ounces in 1946. The principal gold-producing districts in 1946 were: Lordsburg, Hidalgo County, which produced 39 percent of the State total; Central, Grant County, 30 percent; Steeple Rock, Grant County, 10 percent; Mogollon, Catron County, 8 percent, and Pinos Altos, Grant County, 7 percent. All others produced 6 percent. Copper ore yielded 39 percent of the State total gold, dry and siliceous ores 34 percent, zinc ore 19 percent, and lead and zinc-lead ores and placers 8 percent. The principal producing mines in 1946, in order of output, were: Atwood mine, Lordsburg district, Hidalgo County; Bayard mine, Central district, Grant County; Bonney and Miser's Chest group, Lordsburg district, Hidalgo County; Boston Bicket mine, Central district, Grant County; Carlisle mine, Steeple Rock district, Grant County; Bearup mine, Mogollon district, Catron County; and Houston-Thomas mine, Pinos Altos district, Grant County. These seven properties produced 90 percent of the State total.

Silver.—Mine production of recovered silver in New Mexico declined from 465,127 fine ounces in 1945 to 338,000 ounces in 1946—a 27-percent decrease; in value the decrease was 17 percent. It can be attributed to cessation in 1945 of operations of the Peerless mine, Grant County, and Tom mine group and Crosby mine, Hidalgo County; and to decreased production in 1946 from the Ground Hog Unit of the American Smelting & Refining Co., Hobo mine of the Black Hawk Consolidated Mines Co., Carlisle mine of the Explora tion Syndicate, Inc.—all in Grant County—and the Bearup mine of the Silver Creek Mining Co., Catron County. The principal silver-producing districts in 1946 were: Central, Grant County, which produced 39 percent of the State total; Lordsburg, Hidalgo County, 30 percent; Magdalena, Socorro County, 21 percent; Mogollon, Catron County, 5 percent; and all other districts, 5 percent. Of the total silver produced in the State during 1946, zinc ore yielded 41 percent, copper ore 30 percent, zinc-lead ore 19 percent, dry and siliceous ores 9 percent, and lead ore 1 percent. The following nine producers, in order of output, contributed 93 percent of the State total: United States Smelting, Refining & Mining Co. (Bayard mine) in Grant County, C. H. & S. A. McIntosh (Atwood mine) in Hidalgo County, American Smelting & Refining Co. (Magdalena unit) in Socorro County, Banner Mining Co. (Bonney and Miser's Chest group) in Hidalgo County, American Smelting & Refining Co. (Ground Hog Unit) in Grant County, J. E. Torres and C. S. Elayer (Kelly mine) in Socorro County, Peru Mining Co. and subsidiary (Pewabic, Kearny, and Copper Flat mines) in Grant County, Silver Creek Mining Co. (Bearup mine) in Catron County, and Exploration Syndicate, Inc. (Carlisle mine), in Grant County.

Copper.—Mine production of recovered copper in New Mexico in 1946 was 100,382,000 pounds—an 11-percent decrease from 1945; in value, however, there was a 6-percent increase. The Chino open-pit mine of the Kennecott Copper Corp. at Santa Rita, Grant County, was by far the largest copper producer in the State; the second largest was the Bonney and Miser's Chest group of the Banner Mining Co. south of Lordsburg, Hidalgo County. Other producing mines, in

order of output, were: The leaching operation at the Burro Mountain properties of the Phelps Dodge Corp. at Tyrone, Grant County; the Atwood mine south of Lordsburg, operated by C. H. & S. A. McIntosh, Hidalgo County; the Bayard mine, operated by the United States Smelting, Refining & Mining Co., Grant County; the Magdelena Unit, operated by American Smelting & Refining Co., Socorro County; and the Ground Hog Unit, operated by the American Smelting & Refining Co., Grant County. The above seven mines produced over 99 percent of the State total production of copper in 1946; of the total copper produced, copper ore, mine-water precipitates, and precipitates from leaching dump material accounted for 99 percent.

Lead.—Lead production in New Mexico in 1946 decreased 36 percent in quantity and 19 percent in value from 1945. This decrease can be attributed to cessation of operations in 1945 of the Peerless mine, Grant County, and Tom mine group and Crosby mine, Hidalgo County, and to decreased production in 1946 from the Ground Hog Unit of the American Smelting & Refining Co., the Hobo mine of the Black Hawk Consolidated Mines Co., and the Carlisle mine of the Exploration Syndicate, Inc., all in Grant County. Other producers maintained or reported a slight increase in production. Zinc ore yielded 67 percent of the total lead, zinc-lead ore 26 percent, dry and siliceous ores 4 percent, and copper and lead ores 3 percent. The principal lead-producing districts in 1946 were the Central, Grant County (65 percent); Magdalena, Socorro County (26 percent); Steeple Rock, Grant County (4 percent); Lordsburg, Hidalgo County (2 percent); and Cerrillos, Santa Fe County (1 percent). The nine largest producers of lead in New Mexico supplied 96 percent of the State total; in order of output they were: United States Smelting, Refining & Mining Co. (Bayard mine), Grant County; American Smelting & Refining Co. (Magdalena Unit), Socorro County; American Smelting & Refining Co. (Ground Hog Group), Grant County; J. E. Torres and C. S. Elayer (Kelly mine), Socorro County; Exploration Syndicate, Inc. (Carlisle mine), Grant County; Peru Mining Co. and subsidiary (Pewabic, Kearny, and Copper Flat mines), Grant County; C. H. & S. A. McIntosh (Atwood mine), Hidalgo County; Empire Zinc Co. (Hanover mine group), Grant County; and Moline Mining & Milling Co. (Franklin group), Santa Fe County.

Zinc.—Production of recovered zinc in New Mexico in 1946 decreased 10 percent in quantity and 5 percent in value from 1945. The eight leading producers of zinc in New Mexico in 1946 accounted for 98 percent of that metal and, in order of output, were: United States Smelting, Refining & Mining Co. operating the Bayard mine, Peru Mining Co. and subsidiary operating the Pewabic, Kearny, and Copper Flat mines, Empire Zinc Co. operating the Hanover mine unit, Kennecott Copper Corp. operating the Oswaldo mine, and American Smelting & Refining Co. operating the Ground Hog Unit, all in Grant County; and American Smelting & Refining Co. operating the Magdalena Unit, J. E. Torres and C. S. Elayer operating the Kelly mine, and McDonald & Dobson operating the Nitt mine, all in Socorro County. Zinc ore yielded 91 percent and zinc-lead ore 8 percent of the total zinc. Six mining districts produced all of the recovered zinc in the State. They were the Central, Grant County

(89 percent); Magdalena, Socorro County (10 percent); and Steeple Rock, Pinos Altos, and Swartz, Grant County, together with Cerrillos, Santa Fe County (1 percent). Of the above eight leading zinc producers in New Mexico, the American Smelting & Refining Co. (Magdalena Unit) and J. E. Torres and C. S. Elayer (Kelly mine), in Socorro County, and Kennecott Copper Corp. (Oswaldo mine), in Grant County, mined greater tonnages of ores and had a greater zinc production in 1946 than in 1945. The United States Smelting, Refining & Mining Co. (Bayard mine) and Peru Mining Co. and subsidiary (Pewabic, Kearny, and Copper Flat mines) mined greater tonnages but had a slightly smaller zinc production partly because of the lower grade of large quantities of ores from development work done in 1946. The Empire Zinc Co. (Hanover mine unit) in Grant County and McDonald & Dobson (Nitt mine) in Socorro County treated slightly less ore and produced less zinc. The American Smelting & Refining Co. Hanover Unit, Grant County, was idle from February 24 to June 20 because of a strike of its employees (beginning February 25 and ending June 17) which resulted in a considerable decrease in tonnage of ore mined and zinc produced during 1946.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1946, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Catron	2		319	$11,165	18,187	$14,695
Colfax		1	5	175	1	1
Dona Ana	1				110	89
Grant	23	1	1,911	66,885	145,932	117,913
Hidalgo	5		1,582	55,370	100,963	81,578
Lincoln	1	1	1	35	5	4
Luna	1				26	21
Otero	1				11	9
Santa Fe	4	1	58	2,030	2,016	1,629
Sierra	5		8	280	1,135	917
Socorro	7		125	4,375	69,614	56,248
Total: 1946	50	4	4,009	140,315	338,000	273,104
1945	46	4	5,604	196,140	465,127	330,757

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Catron							$25,860
Colfax							176
Dona Ana			4,000	$436			525
Grant	97,707,000	$15,828,534	6,885,000	750,465	65,179,000	$7,951,838	24,715,635
Hidalgo	2,392,000	387,504	215,000	23,435			547,887
Lincoln			1,000	109			148
Luna							21
Otero	4,000	648					657
Santa Fe	6,000	972	140,000	15,260	79,000	9,638	29,529
Sierra	1,000	162	6,000	654			2,013
Socorro	272,000	44,064	2,547,000	277,623	6,948,000	847,656	1,229,966
Total: 1946	100,382,000	16,261,884	9,798,000	1,067,982	72,206,000	8,809,132	26,552,417
1945	113,142,000	15,274,170	15,324,000	1,317,864	80,590,000	9,267,850	26,386,781

MINING INDUSTRY

During 1946 skilled labor continued to be scarce, but common labor became comparatively plentiful. Materials and supplies were still difficult to obtain. Metal prices, except for gold, increased, as did costs of material and labor.

The Premium Price Plan for copper, lead, and zinc expired June 30. Price control ended on the same date, when legislation for the extension of the Office of Price Administration was vetoed. There was no price control from July 1 to July 25, when a new law was signed by the President, effective July 26. The Premium Price Plan for copper, lead, and zinc was reestablished with some new provisions. This plan, effective until June 30, 1947, was retroactive to July 1; it included allowance of adjustment in premiums, gave allowances for depreciation, and made all classes of premiums noncancellable unless necessary in order to make individual adjustments to specific mines.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in New Mexico in 1946, with content in terms of recovered metals

Source	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	512	697	924	5,888	5,436	
Dry and siliceous gold-silver ore	10,557	687	27,368	88,365	407,240	328,800
Dry and siliceous silver ore	159		1,532	600	9,000	
	11,228	1,384	29,824	94,853	421,676	328,800
Copper ore	6,044,004	1,566	[1] 100,318	[1] 99,275,228	180,087	
Lead ore	737	179	3,537	2,937	122,344	
Zinc ore	487,063	743	140,674	754,786	6,515,316	65,888,449
Zinc-lead ore	51,858	127	63,645	254,196	2,558,577	5,988,751
	6,583,662	2,615	[1] 308,174	[1] 100,287,147	9,376,324	71,877,200
Total lode mines	6,594,890	3,999	[1] 337,998	[1] 100,382,000	9,798,000	72,206,000
Placers		10	2			
Total: 1946	6,594,890	4,009	[1] 338,000	[1] 100,382,000	9,798,000	72,206,000
1945	6,843,327	5,604	[1] 465,127	[1] 113,142,000	15,324,000	80,590,000

[1] Silver and copper contained in precipitates recovered from mine water and leached dumps are included with that in copper ore as follows: 1946, 73 ounces of silver and 20,203,536 pounds of copper; 1945, 381 ounces of silver and 23,855,551 pounds of copper.

METALLURGIC INDUSTRY

Of the 6,594,890 tons of ores from New Mexico mines in 1946, 6,522,646 tons (99 percent) were treated at nine concentrating plants, 135 tons were treated first by amalgamation and then concentration at two small mills, and 72,109 tons were shipped crude to smelters. Of the 6,522,646 tons of ores sent to concentrating plants, 5,974,442 tons were copper ore, 486,862 tons zinc ore, 51,858 tons zinc-lead ore, and 9,484 tons dry and siliceous ores. Of the 72,109 tons of ores sent crude to smelters, 69,562 tons were copper ore, 1,157 tons dry and siliceous gold-silver ore, 737 tons lead ore, 377 tons dry and siliceous gold ore, 201 tons zinc ore, and 75 tons dry and siliceous silver ore.

The nine concentrating plants operating in New Mexico in 1946 were: Hanover Unit of the American Smelting & Refining Co. (company and custom zinc and zinc-lead ores); Magdalena Unit of the American Smelting & Refining Co. (company zinc-lead ore); Banner mill of the Banner Mining Co. (company copper ore); East Camp mill of the Exploration Syndicate, Inc. (company gold-silver ore); Hanover milling unit of the Empire Zinc Co. (company and custom zinc and zinc-lead ores); Hurley concentrating unit of the Kennecott Copper Corp. (company copper ore); Moline mill of the Moline Mining & Milling Co. (company zinc-lead ore); Peru mill of the Peru Mining Co. (company zinc and custom zinc and zinc-lead ores); and Bayard mill (formerly called Bullfrog mill) of the United States Smelting, Refining & Mining Co. (company zinc ore).

The Chino reverberatory copper smelter of the Kennecott Copper Corp. was operated throughout 1946 and treated company copper concentrates, siliceous copper ore, and copper precipitates; the precipitates were derived from the company operation at Chino and company operation at Ray, Ariz. All of the copper produced during the year was marketed as fire-refined copper bars.

Mine production of metals in New Mexico in 1946, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore amalgamated	135	27	61	4,200		
Concentrates smelted	250,081	1,800	[1] 244,481	[1] 99,196,563	9,481,330	72,051,707
Ore smelted	72,109	2,172	93,456	1,181,237	316,670	154,293
Placer		10	2			
Total: 1946		4,009	[1] 338,000	[1] 100,382,000	9,798,000	72,206,000
1945		5,604	[1] 465,127	[1] 113,142,000	15,324,000	80,590,000

[1] Silver and copper contained in precipitates recovered from mine water and leached dumps are included with that in copper concentrates as follows: 1946, 73 ounces of silver and 20,203,536 pounds of copper; 1945 381 ounces of silver and 23,855,551 pounds of copper.

Mine production of metals from amalgamation mills (with or without concentration equipment) in New Mexico in 1946, by counties, in terms of recovered metals

County	Ore treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal			
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)
Santa Fe	100	6	1	11	10	55	4,200
Socorro	35	11	5				
Total 1946 [1]	135	17	6	11	10	55	4,200

[1] No ore treated in amalgamation mills in 1945.

Gross metal content of concentrates (all produced at concentrating mills) from ores mined in New Mexico in 1946, by classes of concentrates smelted

Class of concentrates	Concentrates produced (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (wet assay) (pounds)	Lead (wet assay) (pounds)	Zinc (pounds)
Copper	169,645	5,336	[1] 98,144	[1] 100,700,083	1,042	862
Lead	6,792	754	130,897	520,203	8,180,168	1,076,685
Zinc	73,644	508	95,417	830,538	1,959,714	79,405,403
Total: 1946	250,081	6,598	[1] 324,458	[1] 102,050,824	10,140,924	80,482,950
1945	266,259	6,978	[1] 372,553	[1] 113,328,738	14,475,798	90,469,815

[1] Silver and copper contained in precipitates recovered from mine water and leached dumps are included with that in copper concentrates as follows: 1946, 89 ounces of silver and 20,630,891 pounds of copper; 1945, 405 ounces of silver and 24,348,144 pounds of copper.

Mine production of metals from concentrating mills in New Mexico in 1946, in terms of recovered metals

BY COUNTIES

	Ore treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dona Ana	84	14		110		4,000	
Grant	6,424,874	236,719	1,099	[1] 141,204	[1] 97,101,213	6,847,008	65,024,707
Hidalgo	41,208	3,799	571	31,950	1,823,303		
Santa Fe	2,166	209	17	1,952	1,800	140,000	79,000
Socorro	54,314	9,340	113	69,265	270,247	2,490,322	6,948,000
Total: 1946	6,522,646	250,081	1,800	[1] 244,481	[1] 99,196,563	9,481,330	72,051,707
1945	6,764,415	266,259	2,407	[1] 287,960	[1] 110,782,151	13,651,594	80,590,000

BY CLASSES OF CONCENTRATES

Dry and siliceous gold-silver	9,400	865	359	8,639	87,265	403,640	328,800
Dry and siliceous silver	84	14		110		4,000	
Copper	5,974,442	169,638	571	[1] 32,023	[1] 98,104,146		
Zinc	486,862	71,162	743	140,064	750,956	6,515,113	65,734,156
Zinc-lead	51,858	8,402	127	63,645	254,196	2,558,577	5,988,751
Total 1946	6,522,646	250,081	1,800	[1] 244,481	[1] 99,196,563	9,481,330	72,051,707

[1] Silver and copper contained in precipitates recovered from mine water and leached dumps are included with that in copper concentrates as follows: 1946, 73 ounces of silver and 20,203,536 pounds of copper; 1945 381 ounces of silver and 23,855,551 pounds of copper.

Gross metal content of New Mexico crude ore shipped to smelters in 1946, by classes of ore

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	377	670	863	2,196	7,077	2,400
Dry and siliceous gold-silver	1,157	328	18,729	1,768	3,754	----
Dry and siliceous silver	75	----	1,422	696	5,375	----
Copper	69,562	1,037	69,092	1,605,316	300,784	668,500
Lead	737	179	3,537	3,583	127,915	50,500
Total to copper and lead plants	71,908	2,214	93,643	1,613,559	444,905	721,400
Zinc: Total to zinc plants	201	----	1,011	7,664	393	184,524
Total: 1946	72,109	2,214	94,654	1,621,223	445,298	905,924
1945	78,912	3,182	177,160	2,426,458	1,868,048	37,133

Mine production of metals from New Mexico crude ore shipped to smelters in 1946, by counties, in terms of recovered metals

County	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Catron	1,090	319	18,187	----	----	----
Grant	57,155	811	4,728	605,787	37,992	154,293
Hidalgo	13,521	1,011	69,013	568,697	215,000	----
Lincoln	2	----	5	----	1,000	----
Luna	2	----	26	----	----	----
Otero	31	----	11	4,000	----	----
Santa Fe	8	22	7	----	----	----
Sierra	74	8	1,135	1,000	6,000	----
Socorro	226	1	344	1,753	56,678	----
Total: 1946	72,109	2,172	93,456	1,181,237	316,670	154,293
1945	78,912	3,182	177,160	2,359,849	1,672,406	----

REVIEW BY COUNTIES AND DISTRICTS

CATRON COUNTY

Mogollon District.—The Silver Creek Mining Co. operated the Bearup group on Silver Creek about 8 miles north of Glenwood throughout 1946 and shipped 1,090 tons of dry gold-silver ore containing 318 ounces of gold, 18,173 ounces of silver, and 467 pounds of copper. Development included 50 feet of shaft and 150 feet of drifts. The Bradley Mining Co. continued extension and repair (begun in 1945) of the Oaks tunnel, but produced no ore.

DONA ANA COUNTY

Organ District.—J. H. Brown treated about 84 tons of ore, chiefly from dumps of the Torpedo group, in a small gravity-concentration plant and shipped 14 tons of lead concentrates containing 110 ounces of silver and 4,929 pounds of lead. Geophysical and magnetometer work was done in the district by the Empire Zinc Co. in 1946 preparatory to a diamond-drilling program to begin in 1947.

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1946, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)		
	Lode	Placer		Lode	Placer	Total
Catron County: Mogollon	2		1,090	319		319
Colfax County: Mount Baldy		1			5	5
Dona Ana County: Organ	1		84			
Grant County:						
Black Hawk	1		67	9		9
Central [1]	13		6,470,856	1,210		1,210
Chloride Flat	1		23			
Pinos Altos	2	1	652	265	1	266
Steeple Rock	3		9,535	408		408
Swartz	1		873	1		1
White Signal	2		19	17		17
Hidalgo County: Lordsburg	5		54,729	1,582		1,582
Lincoln County:						
Jicarilla		1			1	1
Nogal	1		2			
Luna County: Tres Hermanas	1		2			
Otero County: Sacramento	1		31			
Santa Fe County:						
Cerrillos	2		2,166	17		17
San Pedro (New Placers)	2	1	108	38	3	41
Sierra County:						
Hermosa	1		12	1		1
Kingston	2		50			
Las Animas (Hillsboro)	2		12	7		7
Socorro County:						
Magdalena	4		54,535	114		114
Oscura Mountain	1		5			
San Mateo Mountains	1		5	5		5
Silver Mountain	1		30	6		6
Total New Mexico	50	4	6,594,890	3,999	10	4,009

County and district	Silver (fine ounces)			Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer	Total				
Catron County: Mogollon	18,187		18,187				$25,860
Colfax County: Mount Baldy		1	1				176
Dona Ana County: Organ	110		110		4,000		525
Grant County:							
Black Hawk	542		542	1,100	3,600		1,323
Central [1]	[2] 131,911		[2] 131,911	[3] 97,611,500	6,398,600	64,557,000	24,535,398
Chloride Flat	1,141		1,141		400		966
Pinos Altos	2,729		2,729	4,300	29,100	161,000	35,026
Steeple Rock	8,797		8,797	87,800	405,200	328,800	119,893
Swartz	661		661	1,600	46,200	132,200	21,992
White Signal	151		151	700	1,900		1,037
Hidalgo County: Lordsburg	100,963		100,963	2,392,000	215,000		547,887
Lincoln County:							
Jicarilla							35
Nogal	5		5		1,000		113
Luna County: Tres Hermanas	26		26				21
Otero County: Sacramento	11		11	4,000			657
Santa Fe County:							
Cerrillos	1,952		1,952	1,800	140,000	79,000	27,362
San Pedro (New Placers)	63	1	64	4,200			2,167
Sierra County:							
Hermosa	797		797		1,400		832
Kingston	255		255	600	4,600		804
Las Animas (Hillsboro)	83		83	400			377
Socorro County:							
Magdalena	69,607		69,607	271,800	2,546,600	6,948,000	1,229,499
Oscura Mountain	2		2	200	400		78
San Mateo Mountains	3		3				177
Silver Mountain	2		2				212
Total New Mexico	[2] 337,998	2	[2] 338,000	[3] 100,382,000	9,798,000	72,206,000	26,552,417

[1] Includes Burro Mountain district, silver and copper, figures for which Bureau of Mines is not at liberty to publish separately.
[2] Includes silver recovered from precipitates.
[3] Includes copper recovered from precipitates.

GRANT COUNTY

Black Hawk District.—Saunders & Billingsley shipped 67 tons of gold-silver ore from the Astrologer and Rover claims in July. The properties are about 2 miles south of Tyrone.

Burro Mountain (Tyrone) District.—Leaching operations at the Burro Mountain mine of the Phelps Dodge Corp. were continued throughout 1946, except for the period March 4 to July 1, when workers were on strike. Water is percolated through subsided areas of the former mine workings, and copper is precipitated from the return solutions in wooden precipitating tanks that can handle about 600 gallons per minute. Robert P. Thompson precipitated copper from copper-carrying waters originating in the Liberty Bell mine.

Central (Bayard, Fierro, Georgetown, Hanover, Santa Rita) District.—The Chino Mines Division of the Kennecott Copper Corp., the largest copper producer in New Mexico, operated its open-pit mine at Santa Rita and its flotation mill and reverberatory copper smelter at Hurley at near capacity during 1946. The mill was operated on a 6-day week for 8 months and a 5-day week for 4 months. Production was not as great as for 1940 to 1945, inclusive, when the plant was operated at and above rated capacity. Copper produced in 1946 was marketed in the form of fire-refined copper bars; as a result, molybdenite was the only byproduct made from ore containing gold, silver, copper, and molybdenum. Copper was recovered also by leaching accumulated dump material from the pit and from siliceous copper ore used in the converter as flux. The company began construction of two large thickeners to reclaim more water from the mill tailings; it is estimated that 500 gallons per minute of "new" water will be available as a result of this work. The company continued development of its Oswaldo zinc property and shipped increasing quantities of zinc ore to the Empire Zinc Co. mill at Hanover. Development at the Oswaldo mine in 1946 included 2,063 feet of drifts, 162 feet of raises, and 15,544 feet of diamond drilling.

The United States Smelting, Refining & Mining Co. operated several properties in the Central district under the single name "Bayard mine" and was the largest producer of zinc and lead in New Mexico in 1946. The ore was treated at the company 450-ton selective-flotation mill. Lead concentrates were made and shipped to the El Paso, Tex., smelter and zinc concentrates to the Anaconda and Great Falls, Mont., electrolytic plants. The company purchased the Combination, Hobo, and Hobo No. 2 mines on lease and option from the Black Hawk Consolidated Mines Co.; possession was taken July 1, 1946.

The Empire Zinc Co. operated its Hanover mine group and selective-flotation mill throughout 1946. In addition to ore from the company properties in the Central district, the mill treated ore from the Kelly mine group at Kelly, Socorro County; Oswaldo mine of the Kennecott Copper Corp. in the Central district, Grant County; and Cleveland mine in the Pinos Altos district, Grant County. Zinc concentrates were shipped to Palmerton, Pa., and Depue, Ill., smelters; lead concentrates were shipped to the American Smelting & Refining Co. El Paso, Tex., smelter.

The Peru Mining Co. operated the Pewabic mine throughout 1946. The New Mexico Consolidated Mining Co., a subsidiary of the Peru

Mining Co., operated the Kearny mine throughout the year and the Copper Flat mine for 9 months. Development in 1946 included 910 feet of drifts and 2,933 feet of diamond drilling in the Pewabic mine and 1,480 feet of drifts and 2,959 feet of diamond drilling in the Kearny mine. Ore from the mines was treated at the Peru 1,000-ton selective-flotation mill at Wemple, 5 miles north of Deming, Luna County. In addition to company ores, the mill treated custom ores from the Phelps Dodge Corp. Campbell Junction mine at Bisbee, Ariz., and the Nitt mine, Magdalena district, Socorro County. Zinc concentrates were shipped to the Dumas, Tex., smelter and lead concentrates to the El Paso, Tex., smelter.

The American Smelting & Refining Co. operated its Ground Hog group in the Central district and the leased 400-ton Hanover milling unit (formerly Combination-Black Hawk mill) continuously throughout 1946, except for the period of a labor strike, February 25 to June 17 (actual operation was resumed June 20). Custom ores were treated in the Hanover milling unit from the Hobo mine in the Central district, Houston-Thomas mine in the Pinos Altos district, and Royal John mine in the Swartz district, all in Grant County; the Nitt mine in the Magdalena district, Socorro County; and Pennsylvania mine in the Cerrillos district, Santa Fe County. Stock-piled ore (from the Hobo mine) of the Office of the Metals Reserve was also milled in the Hanover unit. Development at the Ground Hog group included 4,813 feet of crosscuts and raises and 20,013 feet of diamond drilling. Further improvements in mine ventilation were made during the year.

The Black Hawk Consolidated Mines Co. operated its Hobo mine from January 1 to May 1 and produced 3,539 tons of zinc ore, which were shipped to the Hanover milling unit of the American Smelting & Refining Co. Possession of the mine (purchased on lease and option) was taken by the United States Smelting, Refining & Mining Co. on July 1, 1946.

A. Vigil & Sons shipped 81 tons of gold ore from the Little Goat mine to the El Paso smelter, and Cesario Holguin shipped 62 tons of high-grade gold ore from the Boston Bicket mine to the El Paso smelter.

Steeple Rock District.—The Exploration Syndicate, Inc., operated its 125-ton selective-flotation mill and leased Carlisle group of mines from January 1 to July 1, when the mine was closed. Shipments of concentrates were resumed again in November. Elayer & Richmond operated the Center and Pennsylvania mines from January 1 through April 10, 1946, and produced 120 tons of gold ore containing 32 ounces of gold, 96 ounces of silver, 552 pounds of copper, 2,640 pounds of lead, and 2,400 pounds of zinc. Development included 100 feet of drifts and 200 feet of diamond drilling. J. A. Nard shipped 15 tons of gold ore from the Rival mine to Hawley & Hawley, bullion buyers at Douglas, Ariz. The ore contained 17 ounces of gold and 62 ounces of silver.

Swartz (Carpenter, Camp Monarch) District.—A. L. Owen operated the Royal John mine and shipped 877 tons of ore from July through October to the American Smelting & Refining Co. Hanover milling unit. The ore contained 2 ounces of gold, 842 ounces of silver, 2,631 pounds of copper, 68,278 pounds of lead, and 170,208 pounds of zinc.

HIDALGO COUNTY

Lordsburg District.—The Banner Mining Co., the largest producer in Hidalgo County in 1946, operated its Bonney and Miser's Chest group of copper mines and 500-ton flotation mill throughout the year. The mill operated 6 days a week and handled an average of 110 tons of ore a day; copper concentrates were made and shipped to the El Paso, Tex., smelter. Development included 102 feet of shaft, 2,061 feet of drifts, and 568 feet of diamond drilling. Improvements at the mine included construction of a change house at the Miser's Chest mine.

The Atwood group of claims on Atwood Hill near Valedon 4 miles south of Lordsburg was operated throughout the year by C. H. & S. A. McIntosh. The mine was worked through a three-compartment vertical shaft 800 feet deep with crosscuts to the vein at three levels—the 210-foot, 350-foot, and 500-foot. The shrinkage-stope method of mining is used. Most of the mining and development during 1946 was carried on at the 500-foot level. Development included 800 feet of drifts, 200 feet of crosscuts, and 700 feet of diamond drilling. A new air compressor and additional water pumps were installed during the year. By the end of the year production had been increased to about 100 tons of ore a day. The ore was shipped crude to the El Paso, Tex., smelter.

SANTA FE COUNTY

Cerrillos District.—The Moline Mining & Milling Co. operated its 35-ton selective-flotation mill intermittently from January 1 through August 3 on zinc-lead ore, chiefly from the Franklin claim. Approximately 2,000 tons of zinc-lead ore were produced, which yielded 93 tons of lead concentrates, containing 16 ounces of gold, 1,313 ounces of silver, 1,195 pounds of copper, and 103,780 pounds of lead, and 44 tons of zinc concentrates, containing 1 ounce of gold, 163 ounces of silver, 295 pounds of copper, 9,477 pounds of lead, and 39,512 pounds of zinc. The Cerrillos Lead & Zinc Co. operated the Pennsylvania group of mines from January 1 to August 15 and produced 166 tons of zinc-lead ore containing 3 ounces of gold, 680 ounces of silver, 1,111 pounds of copper, 43,866 pounds of lead, and 57,491 pounds of zinc. The ore was shipped to the American Smelting & Refining Co. Hanover milling unit for treatment.

San Pedro (New Placers) District.—The Shamrock Gold Mining Co. operated the Padilla mine and 25-ton amalgamation-concentration mill (built in 1946) 2 weeks in November and treated 100 tons of gold-silver-copper ore. Six ounces of gold and 1 ounce of silver were recovered as bullion; and 11 tons of copper concentrates were made, which contained 10 ounces of gold, 55 ounces of silver, and 4,618 pounds of copper.

SOCORRO COUNTY

Magdalena District.—The American Smelting & Refining Co. operated its Magdalena unit (Waldo mine) and 200-ton selective-flotation mill throughout 1946. The mill was operated three shifts, 4 days a week; lead concentrates and zinc concentrates were sent to Texas smelters. The crude ore is crushed at the mine plant and delivered to the mill over a 1-mile aerial tram; secondary crushing is done at the mill. Development included 2,171 feet of drifts and 13,601 feet of diamond drilling.

Oregon

Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By ALFRED L. RANSOME

GENERAL SUMMARY

PRODUCTION of gold in Oregon in 1946 was four times the 1945 output, owing largely to dredging operations, but the total recovered was only 16 percent of the all-time record set in 1940. Silver production was down to 66 percent of the 1945 output, and copper and lead production remained extremely low. No zinc production was reported.

The total value of the gold, silver, copper, and lead (in terms of recovered metals) produced in Oregon was $624,231 in 1946 compared with $164,456 in 1945 and $4,148,271 in the peak year 1940. It was divided among the metals as follows: Gold, 98.7 percent; silver, 0.9 percent; copper and lead combined, 0.4 percent. Baker County continued to be the leading metal producer and contributed 55 percent of the State total value; Grant County yielded 34 percent, Jackson, Josephine, and Lane Counties each 3 percent, and the other seven producing counties 2 percent.

The major portion of the increased value of production came from placer gold operations, largely worked by connected-bucket dredges. There was an increasing number of dragline dredges in operation in 1946—the first year that any have been in operation since 1942, when gold mines were closed as the result of War Production Board Limitation Order L–208. Both placer and lode mines continued to face increasing costs and the problem of obtaining labor and supplies. Because of these factors and because of the smelter strike during the first half of 1946, the relatively minor contribution to output made by lode mines did not appear until late in the year.

Placer mines contributed 94 percent and lode mines 6 percent of the gold produced in Oregon in 1946. In 1945 the ratio was placer mines 89 percent and lode mines 11 percent.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

Yardage figures used in measuring material treated in placer operations are bank measure; that is, the material is measured in the ground before treatment.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1942–46

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1942	$35.00	$0.711+	$0.121	$0.067	$0.093
1943	35.00	.711+	.130	.075	.108
1944	35.00	.711+	.135	.080	.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+($20.671835) per fine ounce.
[2] Treasury buying price for newly mined silver. 1942 to June 30, 1946: $0.71111111; July 1 to Dec. 31, 1946: $0.905.
[3] Yearly average weighted price of all grades of primary metal sold by producers; price includes bonus payments by Office of Metals Reserve for overquota production.

Mine production of gold, silver, copper, lead, and zinc in Oregon, 1942–46, and total, 1852–1946, in terms of recovered metals

Year	Mines producing [1]		Ore, old tailings, etc. (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1942	48	83	31,728	46,233	$1,618,155	87,376	$62,134
1943	16	16	2,680	1,097	38,395	10,523	7,483
1944	13	10	4,217	1,369	47,915	20,243	14,395
1945	9	10	1,378	4,467	156,345	10,461	7,439
1946	23	37	3,246	17,598	615,930	6,927	5,597
1852–1946			[2]	5,691,552	127,167,363	5,225,312	4,794,435

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1942	296,000	$24,926	46,000	$3,082			$1,708,297
1943	12,000	1,560	8,000	600			48,038
1944	6,000	810	8,000	640			63,760
1945	2,000	270	2,000	172	2,000	$230	164,456
1946	14,000	2,268	4,000	436			624,231
1852–1946	[3] 12,343	4,640,563	[3] 748	76,781	[3] 141	14,076	136,693,218

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Figure not available
[3] Short tons.

Gold produced at placer mines in Oregon, 1942–46, by classes of mines and by methods of recovery

Class and method	Mines producing [1]	Material treated (cubic yards)	Gold recovered		
			Fine ounces	Value	Average per cubic yard
Surface placers:					
Gravel mechanically handled:					
Connected-bucket dredges:					
1942	6	4,725,000	21,641	$757,435	$0.160
1943–44					
1945	3	1,895,000	3,763	131,705	.070
1946	4	5,116,000	13,793	482,755	.094
Dragline: [2]					
1942	14	2,852,000	13,383	468,405	.164
1943	(3)		5	175	
1944–45					
1946	9	252,000	1,910	66,850	.265
Suction dredges: [4]					
1942–45					
1946	2	15,000	155	5,425	.362
Nonfloating washing plants: [5]					
1942	6	45,000	380	13,300	.296
1943	(3)		17	595	
1944	(3)		71	2,485	
1945					
1946	1	4,200	45	1,575	.375
Gravel hydraulically handled:					
Hydraulic:					
1942	41	306,000	1,420	49,700	.162
1943	10	38,000	124	4,340	.114
1944	4	22,700	99	3,465	.153
1945	5	43,000	170	5,950	.138
1946	8	114,000	406	14,210	.125
Small-scale hand methods: [6]					
Wet:					
1942	12	220,500	1,462	51,170	.232
1943	4	2,750	52	1,820	.662
1944	6	7,500	123	4,305	.574
1945	2	3,000	53	1,855	.618
1946	10	16,800	174	6,090	.363
Underground placers:					
Drift:					
1942	4	1,500	50	1,750	1.167
1943	2	250	10	350	1.400
1944–45					
1946	3	1,000	19	665	.665
Grand total placer:					
1942	83	8,150,000	38,336	1,341,760	.165
1943	16	41,000	208	7,280	.178
1944	10	30,200	293	10,255	.340
1945	10	1,941,000	3,986	139,510	.072
1946	37	5,519,000	16,502	577,570	.105

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Includes all placer operations using dragline excavator for delivering gravel to floating washing plant.
[3] Gold from terminal clean-up; property and equipment not counted as producing.
[4] Includes all placer operations using suction pump for delivering gravel to floating washing plant, except those producing less than 100 ounces of gold, which are included under "Small-scale hand methods."
[5] Includes all placer operations using power excavator and washing plant, both on dry land; when washing plant is movable, outfit is termed "dry-land dredge".
[6] Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long toms, dip boxes, pans, etc.

Gold.—Production of gold in Oregon in 1946 increased 294 percent compared with 1945, 94 percent coming from placer mines. Of the total placer gold, connected-bucket dredges recovered 84 percent, dragline dredges 12 precent, hydraulicking 2 percent, and combined small-scale hand methods, drift mines, suction dredging, and non-floating washing plants (with mechanical excavators) 2 percent. All the lode gold was derived from dry and siliceous ores. Although 60 properties produced in 1946 (19 in 1945), the greatest proportion of the gold came from relatively few mines; the following 5 properties, listed in order of output, supplied 83 percent of the State total: Sumpter Valley Dredging Co., Western Gold Dredging Co., Porter & Co., and Sunshine Mining Co. (Burnt River Division)—all connected-bucket dredges—and Associated Dredging Co. (dragline dredge).

Mine production of gold and silver in Oregon in 1946, by months, in fine ounces, in terms of recovered metal

Month	Gold	Silver	Month	Gold	Silver
January	646	159	August	1,994	647
February	483	100	September	1,615	1,764
March	1,634	341	October	1,425	412
April	1,064	176	November	1,520	382
May	1,899	1,623	December	1,235	265
June	2,374	588			
July	1,709	470	Total	17,598	6,927

The monthly production figures given in the accompanying table show a marked increase in gold output in March following the usual seasonal slump due to winter conditions, with the high point of the year reached in June. Production during the latter half of 1946 was somewhat erratic, but the general pattern was one of a decline. Of four connected-bucket dredge operations in Oregon, only two were in operation December 31, the remainder having shut down September 1 and October 15, respectively. None of the dragline dredges was in operation in December.

Silver.—Silver production in Oregon in 1946 decreased 34 percent compared with 1945. Of the State total, Baker County yielded nearly one-half, and most of the remainder came from Grant, Jefferson, and Lane Counties; 53 percent came from lode mines, principally from dry gold ore, and direct smelting was the principal method of recovery. The accompanying table gives the monthly production during 1946. Output was erratic and for the most part tended to follow the trend of gold. The marked increases in May and September reflect periods of substantial production from lode mines.

Copper, Lead, and Zinc.—Most of the copper output of Oregon was from copper ore mined at one property, the balance being a byproduct of ores worked primarily for their gold content. Lead output was entirely a byproduct from gold ores. No zinc was reported recovered.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Oregon in 1946, by counties, in terms of recovered metals

County	Mines producing [1]		Gold					
			Lode		Placer		Total	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Baker	5	6	176	$6,160	9,540	$333,900	9,716	$340,060
Curry	1		18	630			18	630
Grant	1	6	259	9,065	5,735	200,725	5,994	209,790
Harney	1							
Jackson	5	11	76	2,660	518	18,130	594	20,790
Jefferson	1		6	210			6	210
Josephine	3	10	38	1,330	484	16,940	522	18,270
Lake	1		4	140			4	140
Lane	3		454	15,890			454	15,890
Malheur and Union [2]		3			213	7,455	213	7,455
Wheeler	2	1	65	2,275	12	420	77	2,695
Total: 1946	23	37	1,096	38,360	16,502	577,570	17,598	615,930
1945	9	10	481	16,835	3,986	139,510	4,467	156,345

County	Silver (lode and placer) [3]		Copper		Lead		Zinc		Total value
	Fine ounces	Value	Pounds	Value	Pounds	Value	Pounds	Value	
Baker	3,114	$2,516							$342,576
Curry	5	4							634
Grant	1,732	1,399							211,189
Harney	57	46	10,000	$1,620					1,666
Jackson	89	72							20,862
Jefferson	954	771							981
Josephine	74	60							18,330
Lake	6	5							145
Lane	838	677	4,000	648	4,000	$436			17,651
Malheur and Union [2]	44	36							7,491
Wheeler	14	11							2,706
Total: 1946	6,927	5,597	14,000	2,268	4,000	436			624,231
1945	10,461	7,439	2,000	270	2,000	172	2,000	$230	164,456

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Combined to avoid disclosure of individual outputs.
[3] Sources of total silver as follows—1946: 3,698 ounces from lode mines and 3,229 ounces from placers; 1945: 9,672 ounces from lode mines and 789 ounces from placers.

MINING INDUSTRY

Of the 3,246 tons of ore (including 2,630 tons of old tailings) sold or treated in Oregon in 1946, Baker County produced 2,579 tons (including 2,500 tons of old tailings) or 79 percent, Lane County 238 tons or 7 percent, Josephine County 133 tons (including 130 tons of old tailings) or 4 percent, and Harney County 5 percent. Almost 95 percent of the total (including all the old tailings) was dry gold ore, and almost all the remainder was copper ore.

The four properties worked by connected-bucket dredges had one dredge each; at the end of the year only two of the dredges were in operation. Eight dragline dredges washed gravel at nine Oregon

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properties, and one suction-type dredge operated in two locations; none of these types of dredges was in operation at the close of the year.

ORE CLASSIFICATION

Details of ore classification are given in the Gold and Silver chapter of this volume.

Ore and old tailings sold or treated in Oregon in 1946, with content in terms of recovered metals

Source	Material sold or treated		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
	Ore (short tons)	Old tailings (short tons)					
Dry and siliceous gold ore	439	2,630	1,083	2,310	4,000	4,000	
Dry and siliceous gold-silver ore	1		7	377			
Dry and siliceous silver ore	24		6	954			
	464	2,630	1,096	3,641	4,000	4,000	
Copper ore	152			57	10,000		
Total lode mines	616	2,630	1,096	3,698	14,000	4,000	
Placers			16,502	3,229			
Total: 1946	616	2,630	17,598	6,927	14,000	4,000	
1945	1,378		4,467	10,461	2,000	2,000	2,000

METALLURGIC INDUSTRY

Of the State total ore and old tailings (3,246 tons), 81 percent (including all the old tailings) was cyanided, 14 percent was shipped crude to smelters, and 5 percent was amalgamated. Ultimate recovery of 67 percent of the total lode gold was from the smelting of ore, 19 percent was as bullion from the amalgamation of ore, and 14 percent was as bullion from the cyanidation of ore. Of the lode silver recovered, 83 percent was from the direct smelting of ore, 16 percent from ore cyanided, and 1 percent from ore amalgamated. All material requiring smelting was shipped out of the State, as Oregon has no smelters. No data covering quicksilver or cyanide consumption at Oregon mills were obtained in 1946.

Mine production of metals in Oregon in 1946, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore amalgamated	167	207	37			
Ore cyanided	2,632	156	607			
Ore smelted	447	733	3,054	14,000	4,000	
Total lode mines		1,096	3,698	14,000	4,000	
Placers		16,502	3,229			
Total: 1946		17,598	6,927	14,000	4,000	
1945		4,467	10,461	2,000	2,000	2,000

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Oregon in 1946, by types of mills and by counties, in terms of recovered metals

AMALGAMATION MILLS

County	Material treated		Recovered in bullion		Concentrates smelted and metal recovered		
	Ore (short tons)	Old tailings (short tons)	Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)
Baker	77		43	6			
Curry	21		18	5			
Jackson	61		76	15			
Josephine	1		4				
Lane	3		1				
Wheeler	4		65	11			
Total: 1946	167		207	37			
1945	669		102	32	21	43	869

CYANIDATION MILLS

Baker		2,500	122	597			
Josephine	2	130	34	10			
Total: 1946	2	2,630	156	607			
1945	66		81	14			
Grand total: 1946	169	2,630	363	644			
1945	735		183	46	21	43	869

Mine production of metals from Oregon crude ore shipped to smelters in 1946, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Baker	2	11	378			
Grant	31	259	821			
Harney	152		57	10,000		
Jefferson	24	6	954			
Lake	3		6			
Lane	235	453	838	4,000	4,000	
Total: 1946	447	733	3,054	14,000	4,000	
1945	643	255	8,757	2,000	2,000	2,000

BY CLASSES OF ORE

Dry and siliceous gold	270	720	1,666	4,000	4,000	
Dry and siliceous gold-silver	1	7	377			
Dry and siliceous silver	24	6	954			
Copper	152		57	10,000		
Total 1946	447	733	3,054	14,000	4,000	

Gross metal content of Oregon crude ore shipped to smelters in 1946, by classes of ore

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	270	720	1,666	4,398	6,414	----------
Dry and siliceous gold-silver	1	7	377	----------	----------	----------
Dry and siliceous silver	24	6	954	380	1,093	----------
Copper	152	----------	57	10,678	----------	----------
Total: 1946	447	733	3,054	15,456	7,507	----------
1945	643	255	8,757	2,862	3,378	2,667

REVIEW BY COUNTIES AND DISTRICTS

BAKER COUNTY

Cornucopia District.—Pine Creek Placer Co. operated the High-Bar mine, 10 miles northeast of Hereford, from June 10 to July 15. Bench gravel was worked by power shovel and treated in a portable washing plant; 45 ounces of gold and 6 ounces of silver were recovered. The Golden Dredging Co. operated a 1½-cubic yard dragline dredge on Pine Creek near Burnt River from March 17 to May 30 and recovered a substantial quantity of gold and some silver. The equipment was subsequently moved to the Middle Fork, John Day River, near Caribou Creek in Grant County.

Cracker Creek District.—D. N. McTavish, under lease from the Bald Mountain Mine, treated 2,500 tons of old tailings from the Bald Mountain mine during 1946 from which 122 ounces of gold and 597 ounces of silver were recovered by cyanidation. A small quantity of material shipped to a smelter yielded 7 ounces of gold and 377 ounces of silver.

Greenhorn District.—The Sunshine Mining Co. (Burnt River Division) operated a Yuba electric connected-bucket dredge with 3½-cubic foot buckets from March 1 to October 15, 1946; gravel treated during this period yielded 1,098 ounces of gold and 238 ounces of silver.

Sumpter District.—The Sumpter Valley Dredging Co., the largest producer of gold in Oregon in 1946, operated its Yuba electric connected-bucket dredge with 72 9-cubic foot buckets throughout the year. Treatment of 3,085,000 cubic yards of gravel yielded 8,055 ounces of gold and 1,816 ounces of silver.

Upper Burnt River District.—Pat Vinson operated the Dawn O'Day mine from July 15 to August 18, 1946. A small test shipment of gold ore was made to a smelter, and 4 ounces of gold and 1 ounce of silver were recovered.

Virtue District.—Joe J. Davis worked the Virtue mine under lease from March 1 to December 15. A small quantity of gold and some silver were recovered by amalgamation.

Weatherby District.—A few ounces of gold and silver were reported recovered by amalgamation of gold ore from the Lovejoy mine by A. V. Lovejoy during intermittent operation early in 1946.

Mine production of gold, silver, copper, and lead, in Oregon in 1946, by counties and districts, in terms of recovered metals

County and district [1]	Mines producing [2]		Ore and old tailings (short tons)	Gold			Silver (lode and placer) [3] (fine ounces)	Copper (pounds)	Total value
	Lode	Placer		Lode (fine ounces)	Placer (fine ounces)	Total (fine ounces)			
Baker County:									
Baker	1	(4)	5	1	39	40	15		$1,412
Cornucopia		2			301	301	49		10,575
Cracker Creek	1		2,501	129		129	974		5,302
Greenhorn [5]		1			1,098	1,098	238		38,622
Mormon Basin [6]		1			26	26	8		916
Sumpter		1			8,070	8,070	1,819		283,920
Upper Burnt River	1	1	1	4	6	10	5		354
Virtue	1		64	36		36	4		1,263
Wetherby	1		8	6		6	2		212
Curry County: Chetco	1		21	18		18	5		634
Grant County:									
Canyon		4			3,126	3,126	296		109,649
Granite	1	(7)	31	259	(7)	[8] 259	[8] 821		[8] 9,728
Greenhorn [5]		1			729	729	127		25,618
Harney County: Pueblo Mountain	1		152				57	10,000	1,666
Jackson County:									
Gold Hill	1	7	20	60	197	257	38		9,026
Jacksonville	1	4	30	8	321	329	48		11,554
Upper Applegate	3		11	8		8	3		282
Jefferson County: Ashwood	1		24	6		6	954		981
Josephine County:									
Galice		1			13	13	2		457
Grants Pass (Jump off Joe)		3			135	135	15		4,737
Greenback	1	2	2	2	282	284	42		9,974
Illinois River	1	2	130	32	50	82	15		2,882
Waldo	1	2	1	4	4	8			280
Lake County: New Pine Creek (High Grade)	1		3	4		4	6		145
Lane County: Bohemia	3		238	454		454	838	4,000	[9] 17,651
Wheeler County: Antone	2	1	4	65	12	77	14		2,706
Other districts [10]		4			2,093	2,093	532		73,685
Total Oregon	23	37	3,246	1,096	16,502	17,598	6,927	14,000	[9] 624,231

[1] Only those counties and districts shown separately for which Bureau of Mines is at liberty to publish figures; other producing districts listed in footnote 10 and their output included under "Other districts."
[2] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[3] Source of silver: 3,698 ounces from lode mines, 3,229 ounces from placers.
[4] Output from property not classed as a "mine."
[5] Greenhorn district is in Baker and Grant Counties.
[6] Mormon Basin district is in Baker and Malheur Counties.
[7] Included under "Other districts."
[8] Exclusive of placer output which is included under "Other districts."
[9] Includes value of 4,000 pounds of lead from Bohemia district, Lane County.
[10] Includes Granite district (placer), Grant County; Mormon Basin, Malheur County; Camp Carson, Union County.

CURRY COUNTY

Chetco District.—W. D. Bowser operated the Robert E. mine from January 1 to August 1, 1946; 21 tons of ore amalgamated and cyanided yielded 18 ounces of gold and 5 ounces of silver.

GRANT COUNTY

Canyon District.—The Golden Dredging Co., following movement of its 1½-cubic yard dragline equipment from Pine Creek in Baker County, operated on the Middle Fork of the John Day River from July 1 to August 8, 1946. From November 18 to 25 the property was again in operation, but the operator's name had been changed to the Dixie

Dredging Co. A moderate quantity of gold and some silver were recovered. The Western Gold Dredging Co. operated its connected-bucket dredge with 72 6-cubic foot buckets on the John Day River from January 1 to September 1, 1946.

Granite District.—The Buffalo mine was operated intermittently during 1946 by Bruce Dennis. During the latter part of the year the property was acquired from Dennis under lease and bond by a partnership represented by Alan Kissock. Gold ore was shipped to a smelter. Porter & Co. resumed operation of its connected-bucket dredge with 62 4½-cubic foot buckets on April 5 following a period of idleness since October 16, 1942, occasioned by War Production Board Limitation Order L–208. The dredge continued to operate on the property on Clear Creek throughout the remainder of the year. The Associated Dredging Co. operated a ¾-cubic yard Lima dragline excavator and Bodison floating washing plant on Vincent Creek near Bates from June 1 to November 6, 1946; 79,000 cubic yards of gravel yielded 729 ounces of gold and 127 ounces of silver.

HARNEY COUNTY

Pueblo Mountain District.—Harrison Grove shipped copper ore to a smelter from the Northern Light mine.

JACKSON COUNTY

Gold Hill District.—Mardon Bros. amalgamated 20 tons of ore from the Sunrise mine in 1946; 60 ounces of gold and 10 ounces of silver were recovered. The mine was operated from January 15 to April 20. The Crescent Pacific Mining Co. operated a 1¾-cubic yard dragline dredge on Kane's Creek from February 16 to April 10, 1946; treatment of 39,000 cubic yards of gravel yielded 114 ounces of gold and 17 ounces of silver. R. E. Cook hydraulicked 600 cubic yards of gravel from the Lance mine on Foots Creek during a 10-day period in February and recovered 8 ounces of gold. F. G. Lyons and Ellis B. Matherly operated a suction-type dredge on the Rogue River from January 1 to August 19; the operation was carried on in Jackson County from May 11 following a period of operation in Josephine County.

Jacksonville District.—The C. & D. Mining Co. operated a dragline dredge, having a 1¼-cubic yard bucket, from January 1 to May 15. Luyben & Goodwin operated a ¾-cubic yard dragline dredge four blocks north of the Jacksonville Post Office from March 1 to July 1; 2,000 cubic yards of gravel yielded 12 ounces of gold and 2 ounces of silver. Paul Pearce hydraulicked 11,200 cubic yards of old tailings from the Sterling mine from January 1 to May 15 and recovered 82 ounces of gold and 13 ounces of silver. Bert Pankey operated the Red Dog mine from January 15 to March 17; a small tonnage of gold ore was treated by amalgamation.

Upper Applegate District.—George Slade operated the Rock Gulch mine and D. A. Wright the Steamboat mine during the first half of 1946. The small quantity of gold ore produced from each property was treated by amalgamation.

JEFFERSON COUNTY

Ashwood District.—Henry Anderegg operated the Oregon King mine under lease from Oregon King Mines, and in May made one shipment of silver ore for direct smelting.

JOSEPHINE COUNTY

Grants Pass District.—F. G. Lyons and Ellis B. Matherly operated a suction-type dredge on the Rogue River from January 1 to August 19; the operation was carried on in Josephine County until May 10 and subsequently in Jackson County. Hydraulicking was carried on by T. L. Schrader at the Sexton mine from January 1 to April 15.

Greenback District.—M. H. Davis carried on a hydraulicking operation at the Blue Channel mine on Coyote Creek from January 1 to May 1. Vernon L. Story recovered a moderate quantity of gold and a few ounces of silver by hydraulicking at the Buckhorn mine. Charles Lull cyanided a small quantity of gold ore produced from the Copper King mine during October 1946.

Illinois River District.—B. H. Oregon, Ltd., operated a dragline dredge on Sucker Creek from October 10 to November 13. Harry H. McGrath hydraulicked at the Frances mine on Josephine Creek during the early months in 1946. Earl Young cyanided 130 tons of old tailings at the Eureka mine during 1946 and recovered 32 ounces of gold and 8 ounces of silver.

LANE COUNTY

Bohemia District.—Fred J. Bartels operated the Champion mine during 1946 and shipped gold ore for direct smelting. Kenneth O. Watkins operated the Helena mine during the latter part of the year and shipped gold ore to a smelter. A small quantity of copper and lead was recovered from the ore from both properties.

MALHEUR COUNTY

Morman Basin District.—The Placeritas Mining Co. operated a dragline dredge in Morman Basin for a short period in October and November; the dragline excavator was equipped with a 1½-cubic yard bucket.

UNION COUNTY

Camp Carson District.—The Progress Mining Co. operated a dragline dredge on East Fork Creek, tributary of the Grande Ronde River, from May 4 to July 17.

WHEELER COUNTY

Antone District.—A. C., R. T., and Isaac New worked the Oregon Gold mine and Rosa D. claim during 1946; the small quantity of gold ore produced from each property was treated by amalgamation.

SOUTH DAKOTA

Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By S. A. GUSTAVSON

GENERAL SUMMARY

PRODUCTION of gold and silver from lode-gold mining, the principal source of mineral revenue in South Dakota, was valued in 1946 at nearly $11,000,000. This was about 52 percent of the value of the production in 1941, the last prewar year. During 1946, 5 lode-gold mines were operated, 2 continuously and 3 intermittently, as compared with 3 lode mines in 1945, and 10 lode and 41 small placer mines in 1941. In South Dakota 312,247 fine ounces of gold, valued at $10,928,645, were recovered in 1946, compared with 55,948 fine ounces valued at $1,958,180 in 1945. The output of silver, all a byproduct of gold mining, was 86,901 fine ounces valued at $70,216, compared with 26,564 fine ounces valued at $18,890 in 1945.

The Homestake mine supplied 95 percent of the total value of metals produced in 1946 and the Bald Mountain mine most of the remainder. Chiefly due to a shortage of skilled underground workers, both the above companies were operated at only slightly more than half capacity.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1942–46

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1942	$35.00	$0.711+	$0.121	$0.067	$0.093
1943	35.00	.711+	.130	.075	.108
1944	35.00	.711+	.135	.080	.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+ ($20.671835) per fine ounce.

[2] Treasury buying price for newly mined silver. 1942 to June 30, 1946: $0.71111111; July 1, 1946, to Dec. 31, 1946: $0.905.

[3] Yearly average weighted price of all grades of primary metal sold by producers; price includes bonus payments by Office of Metals Reserve for overquota production.

Mine production of gold, silver, copper, lead, and zinc in South Dakota, 1942–46, and total, 1876–1946, in terms of recovered metals [1]

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1942	5	13	1,464,384	522,098	$18,273,430	186,937	$132,933
1943	3	------	204,932	106,444	3,725,540	35,886	25,519
1944	2	------	2,839	11,621	406,735	5,445	3,872
1945	3	------	312,612	55,948	1,958,180	26,564	18,890
1946	5	------	872,242	312,247	10,928,645	86,901	70,216
1876–1946	------	------	(2)	21,046,301	518,217,744	9,688,009	6,900,058

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1942	2,000	$242	170,000	$11,390	230,000	$21,390	$18,439,385
1943	------	------	82,000	6,150	92,000	9,936	3,767,145
1944	2,000	270	68,000	5,440	112,000	12,768	429,085
1945	------	------	------	------	------	------	1,977,070
1946	------	------	------	------	------	------	10,998,861
1876–1946	[3] 106	36,466	[3] 455	58,500	[3] 217	44,094	525,256,862

[1] For total production of gold and silver in South Dakota, by years, see Mineral Resources, 1913, pt. 1, p. 42; Mineral Resources, 1922, pt. 1, p. 194; and subsequent volumes of Mineral Resources and Minerals Yearbook.
[2] Figure not available.
[3] Short tons.

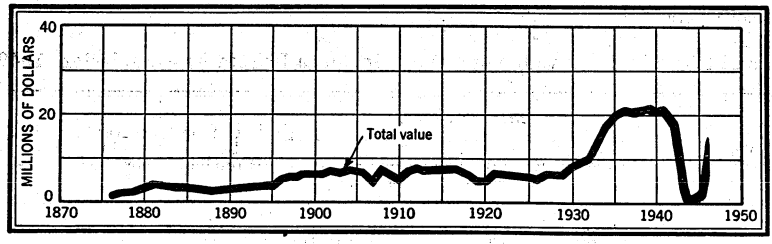

FIGURE 1.—Total value of mine production of gold and silver in South Dakota, 1876–1946.

MINE PRODUCTION BY COUNTIES

Mine production of gold and silver in South Dakota in 1946 by counties, in terms of recovered metals

County	Mines producing		Ore sold or treated (short tons)	Gold (lode and placer)		Silver (lode placer)		Total value
	Lode	Placer		Fine ounces	Value	Fine ounces	Value	
Lawrence	4	------	872,202	312,246	$10,928,610	86,901	$70,216	$10,998,826
Pennington	1	------	40	1	35	------	------	35
Total: 1946	5	------	872,242	312,247	10,928,645	86,901	70,216	10,998,861
1945	3	------	312,612	55,948	1,958,180	26,564	18,890	1,977,070

MINING AND METALLURGIC INDUSTRY

The total ore mined and treated by producers of lode gold and silver in South Dakota in 1946 was 872,242 tons, yielding, in recovered metals, 312,247 fine ounces of gold and 86,901 fine ounces of silver. No copper, lead, or zinc was produced; all ore mined was dry and siliceous gold ore containing no economically recoverable base metal. A break-down by methods of treatment shows that 792,994 tons of ore, yielding 298,470 ounces of gold and 53,668 ounces of silver, were treated by amalgamation followed by cyanidation of sands and slimes; 79,208 tons, yielding 13,776 ounces of gold and 33,233 ounces of silver, were treated by flotation followed by cyanidation, or cyanidation only; and 40 tons, yielding 1 ounce of gold, were treated by amalgamation only.

No recovery of metals has been reported from placer operations since 1942.

Gold and silver bullion produced at mills in South Dakota by amalgamation, 1942–46

Year	Ore treated	Gold in bullion	Silver in bullion	Quicksilver used
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*
1942	1,275,138	276,298.00	56,852	3,561
1943	183,246	69,710.02	13,640	508
1944				
1945	298,830	35,398.00	7,254	1,500
1946	793,034	197,425.00	35,498	(1)

[1] Figure not available.

Gold and silver bullion produced at mills in South Dakota by cyanidation, 1942–46

Year	Material treated				Gold in bullion product	Silver in bullion product	Sodium cyanide used [1]
	Crude ore	Concentrates	Sands and slimes	Total			
	Short tons	*Short tons*	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*
1942	161,635	[2] 366	1,271,305	1,433,306	244,421.00	122,312	801,478
1943	18,772		178,318	197,090	36,679.00	19,048	149,326
1944							
1945	13,782		237,503	251,285	20,550.00	19,310	109,900
1946	79,208		783,103	862,311	114,822.00	51,403	(3)

[1] In terms of 96- to 98-percent strength.
[2] From 17,614 tons of crude ore treated by table and jig concentration.
[3] Figure not available.

REVIEW BY COUNTIES

LAWRENCE COUNTY

Homestake Mine.—The Homestake Mining Co. operated its Homestake mine throughout the year, the first full year of work, except for maintenance, since closing June 8, 1943, because of War Production Board Limitation Order L–208.

Surface plants treated an average of 2,173 tons of ore per day, operating three shifts, 7 days a week. The milling unit consists of

primary crushing plants at the hoists, the South mill, which includes the main secondary crushing (including 180 stamps), grinding, and amalgamating plant, with a capacity of 3,900 tons per 24 hours, cyanide sand plant No. 1, cyanide sand plant No. 3, and the refinery—all at Lead; and the slime plant at Deadwood. At the refinery silver is parted from the gold and virtually pure metals are shipped to the Denver Mint. Development in the mine during the year included 11,924 feet of drifts, 8,014 feet of raises, and 15,304 feet of diamond drilling; no shaft sinking was performed. The annual report of the general manager of the Homestake Mining Co. for the year ended December 31, 1946, says—

Ore mined in 1946 amounted to 792,994 tons which compares with approximately 1,400,000 tons annually before suspension of operations in 1942. Bullion with value of $10,458,896.22 was produced. Average realization was $13.19 per ton and metallurgical recovery was 95.60 percent.

The mine and plant are in excellent condition and functioned without interruption throughout the year. In December, production of ore had reached 70,430 tons and was entirely from shrinkage and timber stopes. Mining of low-grade ore by caving operations on the upper levels, from which a substantial part of the tonnage had to be obtained when operations were resumed after the shut-down, was discontinued in May, which resulted in some temporary decrease in tonnage though it caused little change in output of bullion.

Operating expenses per ton, exclusive of taxes, were higher than in pre-war years because of increases in wages and in cost of supplies and also on account of production being substantially less than capacity.

There are 330,000 tons of broken ore in shrinkage stopes as compared to 167,000 tons at the end of 1945.

The reserve of developed ore including broken ore in shrinkage stopes is 19,845,000 tons, an increase of 866,000 tons over the reserve at the end of 1945.

In 1947 it is expected that progress toward full-scale operations will continue though it will depend upon the rate at which new men can be obtained and trained for mine work. A sufficient number of men are available for all surface work.

Precipitation during 1946 was 40.09 inches as compared to a maximum of 40.75 inches during the forty-two years in which records have been kept. The very heavy rainfall in May caused floods which in places washed out roads and bridges, filled intake dams for the hydro-electric plants and washed out one section of pipeline which resulted in shut-down of Hydro-electric Plant No. 2 for thirty-three days. In general, however, results were beneficial in that hydro-electric power was 20 percent greater than in 1945 and 93 percent above the output in 1940 at the end of a period of dry years.

The operation and output of our sawmill in Spearfish were normal. As our requirements for mine timber are still relatively low, some surplus was available for local needs.

Production of coal from the Wyodak mine was 174,337 tons as compared to a previous record of 122,426 tons. Increasing demand for electric power made additional generating capacity necessary and installation is now in progress.

Ore milled, receipts, and dividends, Homestake mine, 1942–46 [1]

Year	Ore milled (short tons)	Receipts for bullion product		Dividends
		Total	Per ton	
1942	1,275,138	$17,068,437.84	$13.3856	$7,534,800
1943	183,246	3,629,507.33	19.8067	----------
1944	(2)	402,591.29	(2)	----------
1945	298,828	1,873,872.64	6.2707	----------
1946	792,994	10,458,896.22	13.1891	2,812,992

[1] From 1876 to 1946, inclusive, this mine yielded bullion and concentrates that brought a net return of $451,975,133 and paid $152,618,794 in dividends.

[2] No ore milled; bullion product recovered in clean-up of launders, pipe lines, mill liners, and other machinery during course of mill maintenance.

Other Mines.—The Bald Mountain Mining Co. operated its property at Trojan throughout the year, mining chiefly the Portland, Dakota, and Clinton claims. Its 370-ton all-sliming countercurrent-cyanidation plant, also at Trojan, operated 7 days per week on a three-shift basis and treated an average of 214 tons of ore per day. Development by the company included 450 feet of drifts, 843 feet of crosscuts, and 1,744 feet of diamond drilling. The Belle Eldridge Gold Mines, Inc., operated its Belle Eldridge mine and 150-ton flotation and cyanidation mill at Deadwood and made its only shipment of bullion to the Denver Mint in December. Additions to the mill, including a cyanidation section begun in 1945, had been completed early in 1946. Mine development included 1,000 feet of drifting. There were 26 ounces of gold and 65 ounces of silver recovered from ore treated at the Frerichs Mining Co. cyanidation mill during the year.

PENNINGTON COUNTY

R. E. Nelson and James A. Murphy operated the Western Bell lode near Hill City 90 days and treated about 40 tons of ore in their amalgamation plant, recovering about 1 ounce of gold.

TEXAS

Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By S. A. GUSTAVSON

GENERAL SUMMARY

SMALL shipments of zinc concentrates during 1946 from the Bonanza mine, Hudspeth County, marked the first recovery of zinc from Texas ores since 1917. Moreover, plans for a slag-fuming plant at El Paso, construction of which was begun early in 1947, promised to raise Texas to the ranks of substantial zinc producers. The fuming plant would have a large accumulation of zinc-bearing slag to treat as well as hot slag from a lead smelter.

Texas production of gold, silver, copper, lead, and zinc had a total value of $56,950 in 1946. This production was from five mines—three in Hudspeth County and two in Presidio County. In terms of recoverable metals, Texas mines produced 9 fine ounces of gold 42,922 fine ounces of silver, 6,000 pounds of copper, 94,000 pounds of lead, and 88,000 pounds of zinc in 1946, compared with 23,265 fine ounces of silver, 110,000 pounds of copper, and no gold, lead, or zinc in 1945.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1942–46

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1942	$35.00	$0.711+	$0.121	$0.067	$0.093
1943	35.00	.711+	.130	.075	.108
1944	35.00	.711+	.135	.080	.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+($20.671835) per fine ounce.

[2] Treasury buying price for newly mined silver. 1942 to June 30, 1946: $0.71111111; July 1, 1946 to Dec. 31, 1946: $0.905.

[3] Yearly average weighted price of all grades of primary metal sold by producers; price includes bonus payments by the Office of Metals Reserve for overquota production.

MINE PRODUCTION

The following table shows the annual output of ore and the quantity and value of the metals recovered from Texas mines from 1942 to 1946, as well as the total metal production from 1885 to 1946.

Mine production of gold, silver, copper, lead, and zinc in Texas, 1942–46, and total, 1885–1946, in terms of recovered metals

Year	Ore (short tons)	Gold		Silver	
		Fine ounces	Value	Fine ounces	Value
1942	100,698	236	$8,260	672,781	$478,422
1943	4,134	4	140	10,284	7,313
1944	4,160			5,355	3,808
1945	2,693			23,265	16,544
1946	6,705	9	315	42,922	34,681
1885–1946	[1]	8,290	224,095	33,268,363	23,415,061

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1942	198,000	$23,958	362,000	$24,254			$534,894
1943	162,000	21,060	26,000	1,950			30,463
1944	230,000	31,050					34,858
1945	110,000	14,850					31,394
1946	6,000	972	94,000	10,246	88,000	$10,736	56,950
1885–1946	[2] 1,309	370,043	[2] 4,835	499,695	[2] 788	117,227	24,626,121

[1] Figure not available. [2] Short tons.

Mine production of gold, silver, copper, lead, and zinc in Texas in 1946, by counties, in terms of recovered metals

County	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Hudspeth	3	4,441	1	995	5,000	24,000	88,000
Presidio	2	2,264	8	41,927	1,000	70,000	
Total: 1946	5	6,705	9	42,922	6,000	94,000	88,000
1945	4	2,693		23,265	110,000		

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Texas in 1946, with content in terms of recovered metals

Source	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous silver ore	1	2,054	1	41,300	765	28,193	----
Copper ore	1	80	----	18	5,000	----	----
Lead ore	2	221	7	813	235	43,697	----
Total to copper and lead plants	4	2,355	8	42,131	6,000	71,890	----
Zinc ore to zinc plants	1	4,350	1	791	----	22,110	88,000
Total: 1946	5	6,705	9	42,922	6,000	94,000	88,000
1945	4	2,693	----	23,265	110,000	----	----

SMELTING AND REFINING PLANTS IN TEXAS

Texas has in its smelting industry a capacity for the reduction of ores and concentrates containing gold, silver, copper, lead, and zinc far beyond the capacity of its mines and mills to produce them. The industry shows a diversity of smelter products that is equaled only by Montana among the Western States. Texas smelters provide a market for ores and concentrates from mines chiefly in the nearby Western States of New Mexico, Arizona, and Colorado and from mines in foreign countries of the Western Hemisphere; a substantial quantity of smelter residue is treated from other sections of the United States. The industry has abundant supplies of natural gas available as fuel.

In 1946 two horizontal-retort zinc smelters and one electrolytic zinc smelter, one copper smelter, one lead smelter, and one copper refinery were in operation in Texas. The zinc smelters had capacity for producing 134,500 tons of slab zinc at the end of 1946, and the lead and copper smelters had capacity to treat 250,000 tons and 600,000 tons, respectively, of ores and concentrates. Gold and silver ores were absorbed at both lead and copper smelters as flux. The copper refinery had a capacity of 240,000 tons of refined copper.

The American Smelting & Refining Co. operated its lead and copper smelters at El Paso throughout 1946, except from February 5 to June 17, when the workers were on strike. The lead plant consists of two blast furnaces. Ores and concentrates were supplied domestically by operators in Arizona, New Mexico, and Texas, and material was received also from foreign operators in Mexico, Newfoundland, South-West Africa, and Argentina. The copper plant consists of two reverberatory furnaces and three converters. Ores and concentrates were supplied domestically by operators in Arizona, Colo-

rado, New Mexico, and Texas, and foreign material was received from Mexico and Newfoundland. The lead and copper plants also treated residues from other smelting plants. Plans were made and design work was done in 1946 for a slag-fuming plant to treat old slag of the company El Paso smelters for the recovery of zinc; construction was begun early in 1947.

At Amarillo the American Smelting & Refining Co. operated its horizontal-retort zinc smelter throughout the year. The plant is equipped with 8 furnaces having a total of 6,400 horizontal retorts and has an annual rated capacity of 56,500 tons of metal. The plant also makes a highly refined zinc product by further distillation, recovering cadmium oxide as a byproduct from this process. The plant was operated on a 48-hour cycle during 1946. The Office of Metals Reserve maintains a stock pile of concentrates at the plant. Concentrates were received from domestic mines in Arizona, Colorado, New Mexico and Utah and foreign ores from Mexico.

The American Zinc Co. of Illinois operated its Machovec gas-fired horizontal-retort zinc smelter near Dumas throughout 1946. The plant is equipped with 8 furnaces having a total of 6,656 retorts and can produce 48,000 tons of zinc metal annually. A stock pile of zinc concentrates is maintained at the plant by the Office of Metals Reserve. In 1946 concentrates were purchased from operators in Arizona, Colorado, New Mexico, Utah, Mexico and Peru.

Electrolytic zinc was produced throughout 1946 by the American Smelting & Refining Co. at its Corpus Christi plant, which has an annual capacity of 30,000 tons of cathode zinc. The plant treated both foreign and domestic concentrates; it received and stock-piled zinc concentrates for the account of the Office of Metals Reserve.

The Phelps Dodge Corp. Nichols electrolytic copper refinery at El Paso continued to treat blister-copper anodes cast at corporation smelters in Arizona throughout 1946, except for the period March 4 to July 1, when the plant was closed because of a labor strike. Early in the year the plant operated at less than capacity; however, after resuming work July 1, output was increased steadily until capacity production was reached about August 15. This production rate was maintained for the rest of the year. The corporation also has a copper sulfate (blue vitriol) section and a slime plant (for recovery of rare metals and gold, silver, and lead) in connection with the electrolytic plant. The blue vitriol plant has a capacity of 1,000 tons per month. Improvement and remodeling of the slime residue plant was begun during 1946.

REVIEW BY COUNTIES

Hudspeth County.—The Clark Mining Co. operated the Bonanza mine and its 300-ton gravity-concentration mill intermittently throughout 1946. Both the mine and mill are in the Quitman Mountains southwest of Sierra Blanca. The mill treated about 4,350 tons of ore during 78 days of operation; 15 tons of lead concentrates, containing 1 ounce of gold, 791 ounces of silver, and 19,283 pounds of lead, and 112 tons of zinc concentrates, containing 4,524 pounds of lead and 100,156 pounds of zinc, were recovered. The mill consists of a crushing plant having a jaw crusher, two trommels, and two sets of rolls and a concentrating plant consisting of eight Clark-type jigs (three 42 by 42 inches and five 24 by 24 inches). Power for both mill and mine is supplied by gasoline engines.

In January A. T. Barrett shipped 80 tons of ore mined in 1945 from the Black Shaft mine in the Carrizo Mountains, 9 miles north of Allamoore; the ore contained 18 ounces of silver and 5,644 pounds of copper. J. J. Trepanier shipped 11 tons of lead ore from the Big Four mine, Sierra Blanca district, in December.

Presidio County.—M. F. Drunzer, a lessee, operated a part of the Presidio mine and shipped 2,054 tons of silver ore from July through December; the ore contained 1 ounce of gold, 41,300 ounces of silver, 1,056 pounds of copper, and 29,368 pounds of lead. R. I. Carr operated the Carr mine near Presidio from August through December and shipped 210 tons of lead ore containing 7 ounces of gold, 627 ounces of silver, 294 pounds of copper, and 43,704 pounds of lead.

Utah
Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By C. E. NEEDHAM AND PAUL LUFF

GENERAL SUMMARY

PROLONGED labor strikes and continued shortages of labor drove 1946 production of gold, silver, copper, lead, and zinc in Utah down to the lowest levels in recent years. Copper bore the brunt of the precipitous decline, but the output of each of the other four metals also slumped markedly. Despite appreciable increases in average prices of all metals except gold, the value of the five metals in Utah decreased 33 percent from $90,018,641 in 1945 to $60,202,627 in 1946. Of the State total value in 1946, copper contributed 62, zinc 11, lead 11, gold 10, and silver 6 percent. Compared with 1945, the value of the five metals produced in the West Mountain (Bingham) district in 1946 declined 40 percent; the Park City region and the Tintic district showed an opposite trend and gained 22 and 3 percent, respectively.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1942–46

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1942	$35.00	$0.711+	$0.121	$0.067	$0.093
1943	35.00	.711+	.130	.075	.108
1944	35.00	.711+	.135	.080	.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+($20.671835) per fine ounce.

[2] Treasury buying price for newly mined silver. 1942 to June 30, 1946: $0.71111111; July 1, 1946, to Dec. 31, 1946: $0.905.

[3] Yearly average weighted price of all grades of primary metal sold by producers; price includes bonus payments by Office of Metals Reserve for overquota production.

Mine production of gold, silver, copper, lead, and zinc in Utah, 1942–46, and total, 1864–1946, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1942	123	6	34,981,655	391,544	$13,704,040	10,574,955	$7,519,968
1943	110	1	37,386,731	390,470	13,666,450	9,479,340	6,740,864
1944	97		30,940,205	344,223	12,047,805	7,593,075	5,399,520
1945	89		24,723,184	279,979	9,799,265	6,106,545	4,342,432
1946	88	1	13,245,691	178,533	6,248,655	4,118,453	3,327,710
1864–1946			(1)	10,642,978	272,729,270	719,172,519	524,085,762

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1942	613,382,000	$74,219,222	143,860,000	$9,638,620	91,086,000	$8,470,998	$113,552,848
1943	647,978,000	84,237,140	130,514,000	9,788,550	93,792,000	10,129,536	124,562,540
1944	565,150,000	76,295,250	105,038,000	8,403,040	77,988,000	8,890,632	111,036,247
1945	452,752,000	61,121,520	81,634,000	7,020,524	67,260,000	7,734,900	90,018,641
1946	228,568,000	37,028,016	61,422,000	6,694,998	56,584,000	6,903,248	60,202,627
1864–1946	[2] 4,900,441	1,372,390,489	[2] 4,419,040	489,257,574	[2] 983,011	137,971,941	2,796,435,036

[1] 1864–1901: Figures not available; 1902–46: 562,643,449 tons produced. [2] Short tons.

Mine production of gold, silver, copper, lead, and zinc in Utah in 1946, by months, in terms of recovered metals

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
January	16,180	396,113	21,938,000	5,610,000	5,242,000
February	1,580	151,925	602,000	3,054,000	3,374,000
March	1,758	174,970	742,000	3,508,000	3,932,000
April	2,165	169,430	752,000	3,356,000	3,726,000
May	2,890	171,477	744,000	3,510,000	3,476,000
June	2,780	151,290	614,000	3,124,000	3,334,000
July	16,665	389,205	24,696,000	5,088,000	4,026,000
August	20,785	444,350	27,550,000	6,114,000	4,920,000
September	25,125	466,488	34,934,000	5,818,000	5,070,000
October	25,780	487,510	35,540,000	6,242,000	5,690,000
November	23,915	500,375	33,918,000	7,396,000	6,348,000
December	38,910	615,320	46,538,000	8,602,000	7,446,000
Total: 1946	178,533	4,118,453	228,568,000	61,422,000	56,584,000
1945	279,979	6,106,545	452,752,000	81,634,000	67,260,000

Gold.—The yield of gold in Utah in 1946 experienced a sharp decline of 101,446 ounces (36 percent) from the 1945 output because of labor strikes that seriously affected operations at the principal copper and zinc-lead mines. Copper ore continued to be the chief source of gold, supplying 75 percent of the State output; zinc-lead ore followed with 13 percent; and siliceous ore furnished most of the remainder. One placer was active in 1946.

The West Mountain (Bingham) district remained the leading Utah gold district in 1946, producing 79 percent of the State output. However, production was only 57 percent of that in 1945, mainly because of severe decreases at the Utah Copper mine and the United States & Lark group. The Tintic district, second in position, gained 22 percent in gold output, mainly as a result of a marked increase in production

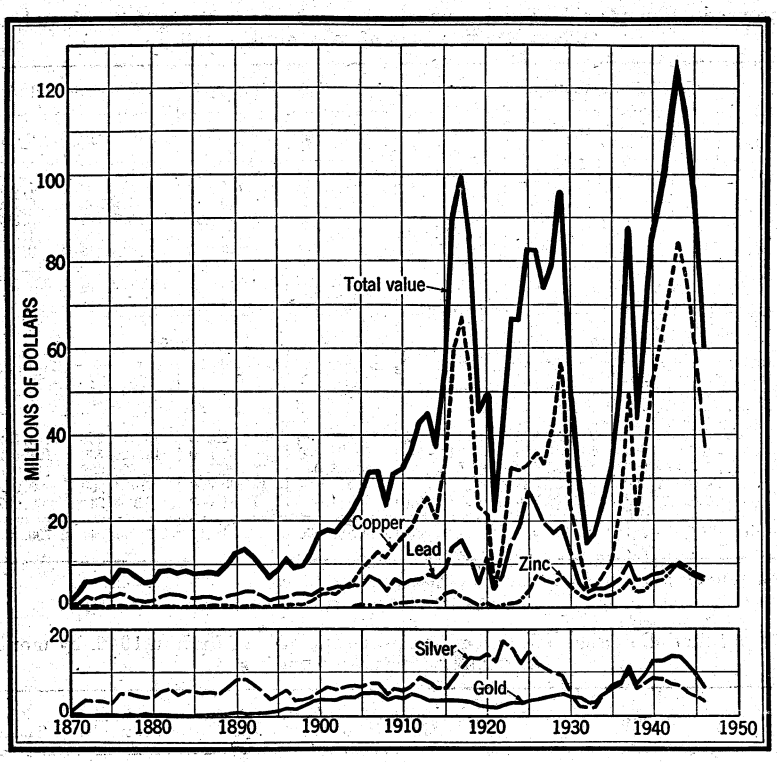

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc, and total value in Utah, 1870–1946

from the Tintic Bullion mine. The Park City region again was in third place and recorded an increase of 23 percent over 1945 output.

Following the Utah Copper mine in State gold output, in the order named, were the New Park Mining Co. property (zinc-lead ore) in the Park City region, the Tintic Bullion mine (gold ore) in the Tintic district, the United States & Lark group (principally zinc-lead ore) and the National Tunnel & Mines Co. property (copper ore and zinc-lead ore) in the West Mountain (Bingham) district, the Calumet mine (zinc-lead ore) in the Rush Valley district, the Butterfield property (zinc-lead ore) in the West Mountain (Bingham) district, and the Tintic Standard mine (lead ore and siliceous ore) in the Tintic district. These eight properties produced 96 percent of the State gold in 1946.

Silver.—The slump of 1,988,092 ounces (nearly 33 percent) from the 1945 output of 6,106,545 ounces dropped Utah production of silver in 1946 to the lowest figure since 1880. Losses were particularly pronounced in the West Mountain (Bingham) district, as silver output for the year at the Utah Copper mine and the United States & Lark group dropped almost 50 percent below that in 1945. Silver production in the Tintic district decreased 43 percent, but only 2 percent in the Park City region, where a substantial gain by the New Park Mining Co. partly counterbalanced declines at other properties in the district.

The Utah Copper mine remained well in the lead among State silver producers in 1946, followed in the order named by the United States & Lark group, the New Park Mining Co. property, Chief Consolidated Mining Co. properties in the Tintic district, Park Utah Consolidated properties and the Silver King Coalition mine in the Park City region, and the Calumet mine. From these seven properties came 82 percent of the State silver in 1946.

Zinc-lead ore, zinc ore, lead ore, and lead-copper ore together supplied over 59 percent of the total silver in Utah in 1946, copper ore 30 percent, and siliceous ores 9 percent; the remainder came from zinc slag fumed.

Copper.—The output of recoverable copper in Utah in 1946 decreased nearly 50 percent from that in 1945 and was the lowest since 1938. All the principal copper-producing operations reported a decline in 1946, the greatest being at the Utah Copper mine of the Kennecott Copper Corp. at Bingham, which was closed by a labor strike from January 21 to June 26. In spite of this, the property remained the leading copper mine in the United States.

Utah mines that yielded over a million pounds of recoverable copper each in 1946 included the Utah Copper mine, the National Tunnel & Mines Co. property, the Columbia group of the Ohio Copper Co.—all in the West Mountain (Bingham) district—and the Big Indian property of the Ohio Copper Co. in the La Sal district, San Juan County. These four properties supplied 98 percent of the State copper in 1946.

Lead.—The lead industry in Utah in 1946 was less affected by labor strikes than the copper industry, yet output of recoverable lead dropped 25 percent below that in 1945 and was the lowest since 1899. Outstanding in the slump were the United States & Lark group and the Tintic Standard properties, which together fell nearly 22,000,000 pounds of lead below the 1945 output; substantial decreases also were noted at a number of other important producers. Reversing the general trend, outstanding gains in yield of recoverable lead were made at the Horn Silver mine in the San Francisco district, the New Park Mining Co. property, the Chief Consolidated Mining Co. properties, and the Tooele slag-fuming plant.

Utah operations that yielded over a million pounds of recoverable lead each in 1946 included, in the order named, the United States & Lark group, the New Park Mining Co. property, the Chief Consolidated Mining Co. properties, the Calumet mine, the Park Utah Consolidated Mining Co. property, the Silver King Coalition mine, the Tooele slag-fuming plant, the Tintic Standard mine, the Butterfield group, and the Horn Silver mine. These 10 properties supplied 89 percent of the State lead in 1946.

About 83 percent of the total lead output was recovered from zinc-lead ores concentrated, and most of the remainder from lead, siliceous, and zinc-lead ores smelted and zinc slag fumed.

Zinc.—Zinc made the best showing among the five metals in Utah in 1946, as the output of recoverable metal declined less than 16 percent from that in 1945; nevertheless, the yield was the lowest since 1934. Mainly because of a 5-month labor strike at the United States & Lark group, output of zinc in the West Mountain (Bingham) district, for years the leading source of zinc in Utah, was reduced to

about half of the 1945 level, permitting the Park City region to advance to first place. Smaller declines were registered at the operations of the Park Utah Consolidated Mines Co., the Tooele slag-fuming plant, the Silver King Coalition Mines Co., and the Calumet mine. Important increases were made by the New Park Mining Co. and the Chief Consolidated Mining Co. The Pacific Bridge Co. began operating an old tailing dump near Park City in August and soon became a major producer of zinc.

The leading producers of zinc in Utah in 1946 were the United States & Lark group, the Tooele slag-fuming plant, and the New Park, Chief Consolidated, Park Utah Consolidated, Calumet, Silver King Coalition, and Pacific Bridge properties. These eight properties furnished 91 percent of the State zinc in 1946.

Zinc-lead ore concentrated supplied 79 percent of the total zinc in 1946, and zinc slag fumed most of the remainder.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Utah in 1946, by counties, in terms of recovered metals

County	Mines producing		Ore (short tons)	Gold		Silver	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
Beaver	10		27,413	503	$17,605	113,469	$91,683
Box Elder	4		578	29	1,015	229	185
Iron	2		348	14	490	307	248
Juab	14		109,225	1,845	64,575	455,230	367,826
Millard		1		7	245		
Piute	3		73	42	1,470	562	454
Salt Lake	12		12,574,603	141,272	4,944,520	2,089,286	1,688,143
San Juan	2		46,382	1	35	557	450
Summit	7		274,475	922	32,270	582,594	470,736
Tooele	19		123,576	1,807	63,245	266,370	215,227
Utah	12		26,181	16,057	561,995	180,328	145,705
Wasatch	2		61,999	16,034	561,190	426,828	344,877
Washington	1		838			2,693	2,176
Total: 1946	88	1	13,245,691	178,533	6,248,655	4,118,453	3,327,710
1945	89		24,723,184	279,979	9,799,265	6,106,545	4,342,432

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaver	295,500	$47,871	2,122,000	$231,298	1,605,000	$195,810	$584,267
Box Elder	26,500	4,293	68,000	7,412	90,000	10,980	23,885
Iron	500	81	44,000	4,796	57,500	7,015	12,630
Juab	176,000	28,512	6,530,000	711,770	7,367,500	898,835	2,071,518
Millard							245
Piute	1,000	162	600	65			2,151
Salt Lake	225,127,500	36,470,655	25,289,400	2,756,545	15,196,000	1,853,912	47,713,775
San Juan	1,012,500	164,025					164,510
Summit	299,500	48,519	9,249,000	1,008,141	8,405,000	1,025,410	2,585,076
Tooele	574,500	93,069	8,144,000	887,696	13,805,500	1,684,271	2,943,508
Utah	284,000	46,008	2,411,000	262,799	710,000	86,620	1,103,127
Wasatch	593,000	96,066	7,496,000	817,064	9,347,500	1,140,395	2,959,592
Washington	177,500	28,755	68,000	7,412			38,343
Total: 1946	228,568,000	37,028,016	61,422,000	6,694,998	56,584,000	6,903,248	60,202,627
1945	452,752,000	61,121,520	81,634,000	7,020,524	67,260,000	7,734,900	90,018,641

MINING INDUSTRY

Ore production in Utah in 1946 was 46 percent less than in 1945, and most of the decline was in copper ore and zinc-lead ore from the West Mountain (Bingham) district. Chief among the causes for this poor showing was the labor strike called January 21, which lasted until June 26 and involved about 5,000 mine, mill, and smelter workers employed by the Kennecott Copper Corp., the United States Smelting, Refining & Mining Co., and the American Smelting & Refining Co. In addition to stopping all work at the properties of the above companies, production was retarded or halted at many other mines using the milling or smelting facilities of the companies concerned. A smaller strike, involving 80 men, affected operations of the Park Utah Consolidated Mines Co. from March 2 to 5.

Following the resumption of major operations in July, production mounted rapidly but was prevented from wiping out the strike-incurred losses largely because of a labor shortage of long standing, and only near the end of the year was the situation eased.

The only new operation of large size in the State in 1946 was that of the Pacific Bridge Co. at Park City—a 1,500-ton plant completed in August for treating old zinc-lead oxide and sulfide tailings. The 4,600-foot transportation tunnel to the floor of the Utah Copper pit to provide an outlet for sublevel copper ore was put into operation in August, and an electric ore-haulage line from the mine to the mills was partly completed.

ORE CLASSIFICATION

Details of ore classification are given in the Gold and Silver chapter of this volume.

Ore sold or treated in Utah in 1946, with content in terms of recovered metals

Source	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	11	3,990	15,227	17,160	73,308	66,279	
Dry and siliceous gold-silver ore	14	41,269	3,072	182,855	377,598	1,459,631	19,486
Dry and siliceous silver ore	18	34,616	776	185,732	159,031	1,514,956	
	43	79,875	19,075	385,747	609,937	3,040,866	19,486
Copper	13	12,471,208	133,454	1,237,060	[1] 224,796,576	13,585	
Lead	33	11,700	1,300	76,870	42,252	3,536,492	274,719
Lead-copper	4	1,236	312	49,620	921,348	537,120	
Zinc	6	[2] 105,222	357	54,056	526,968	2,239,141	10,381,636
Zinc-lead	30	576,450	24,028	2,315,100	1,670,919	52,054,796	45,908,159
Total lode mines	[3] 88	13,245,691	178,526	4,118,453	[1] 228,568,000	61,422,000	56,584,000
Placers	1		7				
Total: 1946	89	13,245,691	178,533	4,118,453	[1] 228,568,000	61,422,000	56,584,000
1945	[4] 89	24,723,184	279,979	6,106,545	[5] 452,752,000	81,634,000	67,260,000

[1] Includes 10,142,892 pounds recovered from mine-water precipitates.
[2] Includes 83,117 tons of zinc slag.
[3] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[4] All lode mines; no placers operated in 1945.
[5] Includes 22,787,627 pounds recovered from mine-water precipitates.

METALLURGIC INDUSTRY

The 13,245,691 tons of ore produced in Utah in 1946 were treated as follows: 13,055,452 tons (nearly 99 percent) at concentrating mills, compared with 24,456,945 tons in 1945; 107,122 tons (nearly 1 percent) shipped crude to smelters, compared with 186,826 tons in 1945; and 83,117 tons (0.6 percent) of old slag fumed, compared with 79,413 tons in 1945.

The 10 concentrating mills active in Utah in 1946 treated ore and old tailings as follows: 5 plants (Arthur, Magna, Ohio Copper, Tooele, and Big Indian), 12,466,732 tons of copper ore and old tailings; 5 mills (Bauer, Midvale, Pacific Bridge, Silver King, and Tooele), 570,720 tons of zinc-lead ore and old tailings and zinc ore; and 1 flotation mill in Summit County, 18,000 tons of current zinc tailings. The custom milling capacity of the concentration mills in the Salt Lake Valley area remained at about 3,900 tons of ore per day, but less than half of this total was used in 1946. The largest custom mill in the area, the Midvale 1,700-ton concentrator of the United States Smelting, Refining & Mining Co., treated largely zinc-lead ore, which came mainly from company-owned properties in the West Mountain (Bingham) district. The plant was closed during the labor strike from late January to the end of June. The copper unit of the International Smelting & Refining Co. concentrator at Tooele operated continuously, but the zinc-lead unit operated at such times during the year as milling ore was available; the bulk of the ore continued to come from custom sources. The 700-ton concentrator of the Combined Metals Reduction Co. at Bauer operated continuously, principally on zinc-lead ore from company-owned or -operated mines in Utah and Idaho. The Silver King Coalition Mines Co. 800-ton concentrator at Park City was active throughout the year and treated only zinc-lead-silver ore from the company mine. The 1,500-ton tailing plant of the Pacific Bridge Co. at Park City operated from August to the end of the year.

The Garfield copper smelter and the Murray lead smelter operated by the American Smelting & Refining Co. and the Midvale lead smelter of the United States Smelting, Refining & Mining Co. all were closed during the 5-month labor strike, and the Tooele copper smelter of the International Smelting & Refining Co. remained idle throughout the year. The Garfield plant continued to operate largely on copper concentrates produced from the Utah Copper mills at Arthur and Magna; the Tooele lead plant of the International Smelting & Refining Co. operated in conjunction with the company slag-fuming plant and treated zinc-lead ores and old slag, zinc-copper ores, lead concentrates, and zinc ores from company-owned operations as well as from custom sources; the Murray plant treated lead concentrates, lead ore, and siliceous ore chiefly from mines in Utah and Idaho; and the Midvale plant treated lead concentrates, lead ore, and siliceous ores principally from company-owned properties in Utah.

Mine production of metals in Utah in 1946, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Concentrates smelted	453,026	156,610	3,473,187	215,849,601	50,764,353	45,036,802
Ore smelted [1]	190,239	21,916	645,266	2,575,507	10,657,647	11,547,198
Mine-water precipitates smelted [2]	6,356			10,142,892		
Total lode		178,526	4,118,453	228,568,000	61,422,000	56,584,000
Placer		7				
Total: 1946		178,533	4,118,453	228,568,000	61,422,000	56,584,000
1945		279,979	6,106,545	452,752,000	81,634,000	67,260,000

[1] Includes 83,117 tons of old slag. [2] All from Salt Lake County.

Gross metal content of concentrates produced from ores mined in Utah in 1946, by classes of concentrates smelted

Class of concentrates	Concentrates (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Copper	334,757	132,647	1,197,164	218,606,031		
Lead	41,933	11,986	1,830,337	1,258,644	46,422,018	5,064,842
Zinc	42,553	4,347	258,766	472,974	3,428,472	45,922,032
Dry iron (from zinc and zinc-lead ore)	33,783	7,637	189,729	300,320	3,037,771	2,875,919
Total: 1946	453,026	156,617	3,475,996	220,637,969	52,888,261	53,862,793
1945	870,935	259,248	4,852,357	436,908,488	73,584,183	65,922,763

Mine production of metals from concentrating mills in Utah in 1946, in terms of recovered metals

BY COUNTIES

	Ore milled (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Beaver	9,631	2,482	144	41,586	13,905	784,963	1,008,236
Iron	29	20		43		6,339	10,378
Juab	78,214	16,787	785	288,505	38,805	4,939,757	7,227,128
Salt Lake	12,552,046	383,472	148,667	1,953,170	213,905,589	23,117,261	15,093,507
San Juan	46,333	1,830		521	1,005,000		
Summit	270,994	16,453	845	557,614	277,867	8,840,853	8,292,259
Tooele	33,849	10,816	956	197,475	25,573	5,191,965	3,390,138
Utah	2,835	1,431	69	14,091	6,901	410,784	667,656
Wasatch	61,521	19,735	15,144	420,182	575,961	7,472,431	9,347,500
Total: 1946	13,055,452	453,026	156,610	3,473,187	215,849,601	50,764,353	45,036,802
1945	24,456,945	870,935	259,077	4,850,504	427,233,200	69,697,635	53,574,745

BY CLASSES OF CONCENTRATES SMELTED

Copper		334,757	132,647	1,197,164	214,234,560		
Lead		41,933	11,986	1,830,337	941,783	44,999,886	1,618,077
Zinc		42,553	4,340	255,957	446,218	3,085,301	43,292,866
Dry iron (from zinc and zinc-lead ore		33,783	7,637	189,729	227,040	2,679,166	125,859
Total 1946		453,026	156,610	3,473,187	215,849,601	50,764,353	45,036,802

Gross metal content of Utah crude ore shipped to smelters in 1946, by classes of ore

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	3,990	15,227	17,160	77,425	95,000	1,995
Dry and siliceous gold-silver	41,269	3,072	182,855	386,239	2,391,740	26,915
Dry and siliceous silver	34,616	776	185,732	162,529	2,525,476	----
Copper	4,476	807	39,896	428,171	22,641	----
Lead	11,700	1,300	76,870	50,217	3,614,490	379,964
Lead-copper	1,236	312	49,620	1,018,607	665,463	----
Zinc[1]	87,138	364	53,925	637,732	2,283,335	14,168,252
Zinc-lead	5,814	69	40,474	67,410	1,327,824	1,358,748
Total: 1946	190,239	21,927	646,532	2,828,330	12,926,469	15,935,874
1945	266,239	21,163	1,290,731	3,585,288	16,189,737	17,977,472

[1] Includes 83,117 tons of old slag.

Mine production of metals from Utah crude ore shipped to smelters in 1946, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Beaver	17,782	359	71,883	281,595	1,337,037	596,764
Box Elder	578	29	229	26,500	68,000	90,000
Iron	319	14	264	500	37,661	47,122
Juab	31,011	1,060	166,725	137,195	1,590,243	140,372
Piute	73	42	562	1,000	600	----
Salt Lake	22,557	2,605	136,116	1,079,019	2,172,139	102,493
San Juan	49	1	36	7,500	----	----
Summit	3,481	77	24,980	21,633	408,147	112,741
Tooele	89,727	851	68,895	548,927	2,952,035	10,415,362
Utah	23,346	15,988	166,237	277,099	2,000,216	42,344
Wasatch	478	890	6,646	17,039	23,569	----
Washington	838	----	2,693	177,500	68,000	----
Total: 1946	190,239	21,916	645,266	2,575,507	10,657,647	11,547,198
1945	266,239	20,902	1,256,041	2,731,073	11,936,365	13,685,255

BY CLASSES OF ORE

Dry and siliceous gold	3,990	15,227	17,160	73,308	66,279	----
Dry and siliceous gold-silver	41,269	3,072	182,855	377,598	1,459,631	19,486
Dry and siliceous silver	34,616	776	185,732	159,031	1,514,956	----
Copper	4,476	807	39,896	419,124	13,585	----
Lead	11,700	1,300	76,870	42,252	3,536,492	274,719
Lead-copper	1,236	312	49,620	921,348	537,120	----
Zinc	87,138	353	52,659	525,356	2,226,216	10,268,789
Zinc-lead	5,814	69	40,474	57,490	1,303,368	984,204
Total 1946	190,239	21,916	645,266	2,575,507	10,657,647	11,547,198

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Utah in 1946, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer							
Beaver County:									
Granite	1		84	19	115		10,000	12,000	$3,312
Rocky	1		3,956	61	6,078	170,000			34,586
San Francisco	3		17,223	366	64,828	59,500	1,073,000	649,500	271,026
Star and North Star	5		6,150	57	42,448	66,000	1,039,000	943,500	275,343
Box Elder County:									
Crater Island	1		95	24	130	4,500			1,674
Lucin	1		114	1	21	21,500			3,535
Park Valley	1		1	3					105
Promontory	1		368	1	78	500	68,000	90,000	18,571
Iron County:									
Indian Peak	1		288	2	208	500	44,000	57,500	12,130
Stateline	1		60	12	99				500
Juab County:									
Mount Nebo	3		4		16		2,000		231
Tintic [1]	10		108,918	1,798	453,641	173,500	6,484,000	7,367,500	2,063,170
West Tintic	1		303	47	1,573	2,500	44,000		8,117
Millard County: House Mountains (Notched Peak)		1		7					245
Piute County:									
Gold Mountain	1		40	13	36				484
Ohio	2		33	29	526	1,000	600		1,667
Salt Lake County:									
Big Cottonwood	1		65	10	401		1,000		783
Little Cottonwood	5		773	68	11,729	45,000	97,400	1,500	29,947
Smelter	(2)	(2)	1,476	317	46,974	916,000	506,000	8,000	253,572
West Mountain (Bingham)	6		12,572,289	140,877	2,030,182	224,166,500	24,685,000	15,186,500	47,429,473
San Juan County:									
La Sal	1		46,333		521	1,005,000			163,231
White Canyon	1		49	1	36	7,500			1,279
Summit County: Uintah	7		274,475	922	582,594	299,500	9,249,000	8,405,000	2,585,076
Tooele County:									
Clifton	2		28		208	1,500	2,000		629
Columbia	1		84		120		2,000	14,500	2,084
Dugway	2		491	2	365	2,500	33,000	103,500	16,994
Erickson	1		37		57		9,000	2,000	1,271
Free Coinage	1		9		36		3,000		356
North Tintic	1		2,900	10	1,464	2,500	210,000	366,000	69,480
Ophir	3		3,734	27	22,380	56,000	671,000	588,500	173,036
Rush Valley [3]	6		115,921	1,315	239,375	511,500	6,980,000	12,730,000	2,636,183
Willow Springs	2		372	453	2,365	500	234,000	1,000	43,475

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Utah in 1946, by counties and districts, in terms of recovered metals—Con.

County and district	Mines producing		Ore sold or treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
	Lode	Placer							
Utah County:									
American Fork	3		2,773	56	14,245	7,000	418,000	658,500	$140,503
Tintic [1]	9		23,408	16,001	166,083	277,000	1,993,000	51,500	962,624
Wasatch County:									
Blue Ledge	1		61,802	16,028	426,682	582,000	7,496,000	9,347,500	2,957,482
Snake Creek	1		197	6	146	11,000			2,110
Washington County: Tutsagubet	1		838		2,693	177,500	68,000		38,343
Total, Utah	88	1	13,245,691	178,533	4,118,453	228,568,000	61,422,000	56,584,000	60,202,627

[1] Tintic district lies in both Juab and Utah Counties.
[2] Properties not counted as mines; material credited to district came from slag dump, clean-ups, and railroad yards.
[3] Includes production from Smelter district; Bureau of Mines not at liberty to publish separate figures.

BEAVER COUNTY

Granite District.—From the Beaver View group, R. A. Glenny, lessee, produced 73 tons of zinc-lead ore and 11 tons of lead ore. Metal content of the zinc-lead ore was 16 ounces of gold, 100 ounces of silver, 9,051 pounds of lead, and 16,784 pounds of zinc; that of the lead ore, 4 ounces of gold, 17 ounces of silver, and 1,337 pounds of lead.

Rocky District.—F. S. Leany, lessee, worked the Old Hickory group until July 1 and thereafter shipped ore from stock piles. Shipments totaled 3,956 tons of gold-silver ore containing 61 ounces of gold, 6,078 ounces of silver, and 173,371 pounds of copper.

San Francisco District.—The Horn Silver mine was operated under lease throughout the year by Metal Producers, Inc. Ore output (16,870 tons) comprised 8,329 tons of silver smelting ore containing 187 ounces of gold, 31,081 ounces of silver, 47,415 pounds of copper, and 593,466 pounds of lead and 8,541 tons of zinc-lead milling ore containing 187 ounces of gold, 38,444 ounces of silver, 19,146 pounds of copper, 804,796 pounds of lead, and 863,189 pounds of zinc. Remaining district output was principally 306 tons of gold ore shipped to a smelter from the Golden Reef group.

Star and North Star District.—James D. Williams, lessee, again worked the Harrington-Hickory group throughout 1946 and produced 3,220 tons of zinc-lead ore containing 28 ounces of gold, 25,537 ounces of silver, 24,908 pounds of copper, 820,463 pounds of lead, and 750,400 pounds of zinc; 499 tons of lead ore containing 5 ounces of gold, 3,490 ounces of silver, 4,038 pounds of copper, and 133,928 pounds of lead; and 127 tons of silver ore containing 1 ounce of gold, 555 ounces of silver, 876 pounds of copper, and 13,062 pounds of lead. Moscow Mines, Inc., operated the Burning Moscow group of claims in 1946 and shipped 570 tons of silver ore, 638 tons of zinc ore, and 836 tons of zinc-lead ore. The remainder of the district output was largely 244 tons of silver-lead ore produced from the Wild Bill and Rebel mines.

BOX ELDER COUNTY

Crater Island District.—About two cars of gold-copper ore from the Copper Blossom mine were shipped to a smelter in 1946.

Lucin District.—Lessees worked the Copper Mountain mine in 1946 and shipped two cars of copper ore to a smelter.

Promontory District.—From the Lake View Carbonate mine the Lakeview Mining Co. shipped 368 tons of zinc-lead ore to a smelter.

IRON COUNTY

Indian Peak District.—The New Arrowhead Mining Co. operated the Arrowhead mine in 1946 and produced 259 tons of zinc-lead smelting ore and 29 tons of zinc-lead milling ore.

Stateline District.—H. J. Holt operated the Etna Gold mine in 1946 and shipped 60 tons of gold ore to a smelter.

JUAB COUNTY

Mount Nebo District.—Lucius Rowe shipped 2 tons of high-grade lead-gold ore to a smelter from the Central Sultana claim, and 2 tons of similar ore were produced from the Mona claim.

Tintic District.—The Tintic district, which lies in both Juab and Utah Counties, is reviewed here. The table that follows gives the metal production in each section of the district in 1946, a comparison with the total in 1945, and the grand total from 1869 to 1946.

Mine production of gold, silver, copper, lead, and zinc in Tintic district, Juab and Utah Counties, Utah, 1945–46, and total, 1869–1946, in terms of recovered metals

	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
1946								
Juab County	10	108,918	1,798	453,641	173,500	6,484,000	7,367,500	$2,063,170
Utah County	9	23,408	16,001	166,083	277,000	1,993,000	51,500	962,624
Total: 1946	19	132,326	17,799	619,724	450,500	8,477,000	7,419,000	3,025,794
1945	18	160,816	14,536	1,086,435	918,000	9,859,000	5,855,400	2,926,511
Total: 1869–1946		(1)	2,588,373	259,815,729	242,745,564	1,863,860,079	68,994,538	393,526,912

[1] Figure not available.

The Chief Consolidated Mining Co. operated its Chief No. 1, Gemini, and Eureka Hill mines throughout 1946. Output from the three mines comprised 77,978 tons of zinc-lead milling ore containing 1,391 ounces of gold, 339,240 ounces of silver, 44,134 pounds of copper, 5,911,248 pounds of lead, and 9,379,179 pounds of zinc; 5,424 tons of silver smelting ore containing 110 ounces of gold, 25,835 ounces of silver, 20,043 pounds of copper, and 368,162 pounds of lead; and 1,726 tons of lead smelting ore containing 22 ounces of gold, 14,970 ounces of silver, 2,089 pounds of copper, 514,311 pounds of lead, and 194,237 pounds of zinc. In 1946 the properties ranked third among State lead producers and fourth in silver and zinc.

Lessees operated the Centennial-Beck-Victoria mine throughout the year and shipped about 200 cars of silver ore to a smelter. Philip P. Clark, lessee, again worked the Godiva mine throughout the year and shipped 1,821 tons of silver ore and lead ore to smelters. The Mammoth Mining Co. increased its output of ore over 1,100 tons, compared with that in 1945; total production of 7,181 tons of smelting ore contained 401 ounces of gold, 20,459 ounces of silver, 66,961 pounds of copper, and 112,003 pounds of lead. Other production from the district was as follows: Dragon and Martha Washington properties, 371 tons of silver ore; Eagle and Blue Bell mine, 801 tons of gold-silver ore; Windridge mine, 293 tons of silver ore; Alaska mine, 94 tons of zinc-lead ore; Showers group, 142 tons of zinc-lead ore and 83 tons of silver-lead ore.

The Tintic Standard Mining Co. operated its Tintic Standard mine the entire year and shipped all production to smelters. Output comprised 8,166 tons of gold-silver ore, which contained 661 ounces of gold, 71,728 ounces of silver, 34,039 pounds of copper, and 650,486 pounds of lead; and 2,781 tons of lead ore, which contained 134 ounces of gold, 19,103 ounces of silver, 6,723 pounds of copper, 1,365,683 pounds of lead, and 57,389 pounds of zinc. The company worked the

Iron Blossom mine from July through December and shipped 1,132 tons of silver ore to a smelter.

The Tintic Bullion mine was operated in 1946 by the North Lily Mining Co. and the International Smelting & Refining Co. Output was high-grade gold ore shipped to a smelter. The mine ranked third among State gold producers in 1946. The Colorado Consolidated Mines Co. operated its Colorado property from July through December and produced 1,935 tons of gold-silver ore which was shipped to a smelter. Owing to smelter strikes, the Yankee mine of the Yankee Consolidated Mining Co. was worked about 7 months; output was 877 tons of gold-silver ore shipped to a smelter. The Eureka Lilly Consolidated Mining Co. operated its Eureka Lilly group about 7 months in 1946 and shipped 3,231 tons of copper-gold-silver ore to a smelter; metal content was 785 ounces of gold, 33,100 ounces of silver, and 164,867 pounds of copper. Other production from this part of the district, all shipped to smelters, included 375 tons of silver ore from the Eureka Bullion mine; 1,611 tons of gold-silver ore from the Mountain View group; and a few cars of silver ore from the Twentieth Century lease.

West Tintic District.—S. L. Jerman, lessee, operated the Scotia group from July to December and shipped to smelters 117 tons of gold-silver ore containing 17 ounces of gold, 606 ounces of silver, 823 pounds of copper, and 14,963 pounds of lead and 186 tons of lead ore containing 30 ounces of gold, 967 ounces of silver, 2,289 pounds of copper, and 36,575 pounds of lead.

PIUTE COUNTY

Gold Mountain District.—From the Annie Laurie claim 40 tons of gold ore were shipped to a smelter.

Ohio District.—Tushar Mines, Inc., operated its Tushar group from July to November and shipped 32 tons of silver ore to a smelter. About 1 ton of lead ore shipped to a smelter from the Cascade claim contained 28 ounces of gold, 32 ounces of silver, and 256 pounds of lead.

SALT LAKE COUNTY

Big Cottonwood District.—Mountain Mines Co. worked the Lake Blanche and other claims from May to December and shipped to a smelter 65 tons of gold-silver ore containing 10 ounces of gold, 401 ounces of silver, and 1,561 pounds of lead.

Little Cottonwood District.—Production from the Little Cottonwood district in 1946 was shipped to smelters and included several cars of lead-copper ore and copper ore from the Wasatch Mines; 207 tons of silver ore from the Michigan-Utah mine dump; 1 ton of high-grade gold ore from the Clementine mine; and a test shipment of lead-copper ore from the Emma & South Hecla mine. In addition, R. G. Shaw worked the Peruvian Consolidated mine from June to October and shipped 106 tons of lead ore and 7 tons of zinc-lead ore to smelters.

Smelter District.—Output credited to the Smelter district in 1946 was lead plant dump slag and clean-ups shipped to a smelter.

West Mountain (Bingham) District.—In 1946 the West Mountain (Bingham) district contributed 79 percent of the State gold output, 49 percent of the silver, 98 percent of the copper, 40 percent of the

lead, and 27 percent of the zinc; the total value of the metal output declined 40 percent from that in 1945. The following table shows production in the district in 1945 and 1946 and the total from 1865 to 1946.

Mine production of gold, silver, copper, lead, and zinc in West Mountain (Bingham) district, Salt Lake County, Utah, 1945–46, and total, 1865–1946, in terms of recovered metals

Year	Mines producing	Ore (short tons)	Gold (lode and placer) (fine ounces)	Silver (lode and placer) (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
1945	8	24,209,565	248,923	3,628,229	448,568,800	45,446,000	29,340,800	$79,131,715
1946	6	12,572,289	140,877	2,030,182	224,166,500	24,685,500	15,186,500	47,429,473
Total: 1865–1946		(1)	5,844,029	143,124,523	[2] 4,670,321	[2] 1,562,029	[2] 479,697	1,802,426,865

[1] Figure not available.
[2] Short tons.

Operations at the Utah Copper mine of the Kennecott Copper Corp. in Bingham were seriously hampered by labor strikes, which closed the mine and mills from January 21 to June 26. As a result, the output of copper ore declined over 50 percent from that in 1935; nevertheless, the mine remained the Nation's leading copper mine and Utah's leading gold and silver producer, as well as an important producer of molybdenum. Copper ore was milled at the Arthur and Magna plants at an average daily rate of 67,566 tons, compared with 67,517 tons in 1945. Important quantities of copper continued to be leached from waste dumps and precipitated at the company plant at Lead Mine in the mouth of Bingham Canyon.

The United States & Lark property, operated by the United States Smelting, Refining & Mining Co., continued to be the largest producer of lead and zinc in the State and ranked second in silver and fourth in gold. Labor strikes closed the mine from January 21 to June 26; consequently, output of ore declined greatly and for 1946 fell 43 percent below that in 1945. The great bulk of the output was zinc-lead ore treated at the company Midvale concentrator, but in addition some gold-silver ore and lead ore were shipped to smelters and a few cars of zinc-lead ore to the Tooele slag-fuming plant.

The National Tunnel & Mines Co. operated the Apex-Delaware group throughout the year; ore production was 25 percent less than in 1945. The output was mainly copper ore treated at the Tooele concentrator, but considerable zinc-lead ore also went to the Tooele concentrator and some to a lead smelter. In 1946 the property ranked second among State copper producers and fifth in gold.

The Columbia group of the Ohio Copper Co. was worked continuously in 1946, and 515,732 tons of old tailings were treated in the company leaching-flotation plant. The yield was 5,277 tons of copper concentrate containing 351 ounces of gold, 3,883 ounces of silver, and 2,177,942 pounds of copper. In addition, 51 tons of precipitated copper were produced.

Combined Metals Reduction Co. and lessees operated the Butterfield group in 1946 and produced 737 tons of gold-silver ore, which

was shipped to a smelter, and 12,252 tons of zinc-lead ore, which was treated at the Bauer mill. Gross metal content of the total ore was 1,422 ounces of gold, 61,012 ounces of silver, 1,669,464 pounds of lead, and 776,832 pounds of zinc.

Montana-Bingham Consolidated Mining Co. operated its property for about 7 months in 1946 and shipped several cars of zinc-lead ore to the Midvale concentrator.

SAN JUAN COUNTY

La Sal District.—The Big Indian open-pit mine of the Ohio Copper Co. was operated throughout 1946. Carbonate copper ore treated in the company 250-ton flotation mill totaled 46,333 tons in 1946, which yielded 1,830 tons of copper concentrate containing 521 ounces of silver and 1,025,433 pounds of copper.

White Canyon District.—Bronson & Cooper worked the Happy Jack claim from September 15 to October 30 and shipped 49 tons of copper ore to a smelter.

SUMMIT AND WASATCH COUNTIES

PARK CITY REGION

The Park City region includes the Uintah district in Summit County and the Blue Ledge and Snake Creek districts in Wasatch County. The following table shows the production and total value of the five metals in 1946 compared with 1945 and the total from 1870 to 1946.

Mine production of gold, silver, copper, lead, and zinc in Park City region, Summit and Wasatch Counties, Utah, 1945–46, and total, 1870–1946, in terms of recovered metals

Year	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
1945	12	154,609	13,822	1,033,830	740,800	17,831,500	14,870,000	$4,562,505
1946	9	336,474	16,956	1,009,422	892,500	16,745,000	17,752,500	5,544,668
Total: 1870–1946	-------	(1)	561,806	234,774,700	68,637,413	2,408,443,934	685,811,111	367,184,321

[1] Figure not available.

The Silver King Coalition Mines Co. operated its mine without interruption during 1946 and produced 28,665 tons of ore compared with 31,117 tons in 1945. Of the 28,665 tons, 28,367 tons of zinc-lead ore were treated in the company 800-ton flotation mill, which yielded 3,003 tons of lead concentrate containing 231 ounces of gold, 208,509 ounces of silver, 114,055 pounds of copper, 4,044,497 pounds of lead, and 434,086 pounds of zinc; and 1,979 tons of zinc concentrate containing 20 ounces of gold, 8,025 ounces of silver, 10,511 pounds of copper, 67,630 pounds of lead, and 2,421,363 pounds of zinc. In addition, direct shipments to smelters comprised 224 tons of silver ore, containing 6 ounces of gold, 2,326 ounces of silver, 721 pounds of copper, and 18,561 pounds of lead and 74 tons of lead ore containing 2 ounces of gold, 1,827 ounces of silver, 639 pounds of copper, and

19,054 pounds of lead. In 1946 the property ranked sixth in State output of silver and lead and seventh in zinc.

In 1946 the Park Utah Consolidated Mines Co. produced 28,401 tons of zinc-lead ore from its Park Utah Consolidated group in Summit and Wasatch Counties, compared with 27,893 tons in 1945. Of the total, 27,834 tons were treated at the Tooele concentrator; gross metal content was 645 ounces of gold, 300,974 ounces of silver, 178,347 pounds of copper, 4,802,538 pounds of lead, and 4,385,938 pounds of zinc. The remaining 567 tons were shipped to a lead smelter; metal content was 13 ounces of gold, 8,301 ounces of silver, 9,109 pounds of copper, 200,344 pounds of lead, and 155,720 pounds of zinc.

In August the Pacific Bridge Co. began production from the Grasselli tailings dump along Silver Creek, and the operation advanced rapidly to a major position in State output of zinc. During the remainder of the year, the company treated 196,793 tons of zinc-lead old tailings in the company 1,500-ton mill by screening, jigging, and spiral concentration, after which the gravity concentrate was treated by selective flotation to produce lead concentrate and zinc concentrate. Concentrates comprised 1,168 tons of lead concentrate—which contained 59 ounces of gold, 35,636 ounces of silver, 24,294 pounds of copper, 485,164 pounds of lead, and 180,830 pounds of zinc—and 1,978 tons of zinc concentrate, which contained 20 ounces of gold, 15,583 ounces of silver, 9,811 pounds of copper, 78,447 pounds of lead, and 2,238,621 pounds of zinc. In 1946 the operation ranked eighth in State zinc output.

The New Park Mining Co. operated its Park Galena and Mayflower properties throughout 1946 and produced 61,802 tons of ore, compared with 50,043 tons in 1945. Of the total, 61,521 tons of zinc-lead ore were treated in custom mills; gross metal content was 17,812 ounces of gold, 447,641 ounces of silver, 795,623 pounds of copper, 8,210,944 pounds of lead, and 11,050,067 pounds of zinc. The remaining 281 tons was gold ore shipped to a smelter; it contained 884 ounces of gold, 6,500 ounces of silver, 8,590 pounds of copper, and 24,402 pounds of lead. In 1946 the property ranked second in State lead and gold production and third in silver and zinc.

The West Park Mining Co. operated its West Park mine from May to November and shipped 197 tons of copper ore to a smelter. Reuben Garbett re-treated about 18,000 tons of current tailings from the Silver King Coalition mill in a small flotation mill and produced 374 tons of zinc middling, which was treated further at the Midvale concentrator. Remaining production from the region was 2,616 tons of old tailings, principally siliceous, shipped to smelters.

TOOELE COUNTY

Clifton District.—Fred Cook shipped 14 tons of lead ore to a smelter from the Herot claim. The Silver King claim produced 14 tons of copper smelting ore.

Columbia District.—Joseph Marshall shipped about 2 cars of zinc ore from the Sultana claim to the Bauer mill for treatment.

Dugway District.—Amos Epperson shipped 483 tons of zinc ore from the Smelter Canyon & Four Metals group to a smelter; and 8 tons of copper ore were produced from the Cannon claim.

Erickson District.—Treloar & Huber produced 37 tons of lead smelting ore from the Esther group.

Free Coinage District.—Eaton Leasers shipped 9 tons of lead ore from the White Quail claim to a smelter.

North Tintic District.—H. A. Bellows worked the waste dump at the Scranton property intermittently during the year and shipped 2,900 tons of zinc ore to a smelter.

Ophir District.—The Ophir Development Co. operated its Ophir Hill mine from February to the end of the year and produced 444 tons of lead smelting ore and 399 tons of zinc-lead milling ore. Gross metal content of lead ore was 4 ounces of gold, 2,868 ounces of silver, 5,492 pounds of copper, 99,445 pounds of lead, and 56,407 pounds of zinc; that of the zinc-lead ore, 3 ounces of gold, 2,467 ounces of silver, 7,418 pounds of copper, 54,979 pounds of lead, and 43,125 pounds of zinc. The Hidden Treasure Mine—the largest producer in the Ophir district in 1946—was worked under lease from September through December; output was 2,034 tons of zinc-lead ore. The Ophir unit of the United States Smelting, Refining & Mining Co. was operated under lease throughout the year and produced 857 tons of zinc-lead ore, nearly all of which was treated at the Midvale concentrator.

Rush Valley District.—The West Calumet (Calumet) mine operated by the Combined Metals Reduction Co. was the largest producer in the Rush Valley district in 1946, ranking fourth in State lead output and sixth in zinc. Output comprised 30,713 tons of zinc-lead ore treated in the Bauer mill and 789 tons of lead ore shipped to a smelter. Metal content of the total ore was 1,723 ounces of gold, 220,918 ounces of silver, 5,889,092 pounds of lead, and 3,983,479 pounds of zinc. The company also operated the Honerine-Galena King and Bluestone groups in 1946. The former group produced 220 tons of lead smelting ore and 252 tons of zinc-lead milling ore; the latter produced 118 tons of lead ore shipped to a smelter. From the Silver Eagle group the Hampton Mining Co. shipped 2 cars of gold-silver ore to a smelter and several cars of zinc-lead ore to custom mills. From the Emilie claim 6 tons of lead ore were shipped to a smelter.

Smelter District.—The slag-fuming plant of the International Smelting & Refining Co. at Tooele ranked second in State production of zinc and seventh in lead in 1946. The plant operated 359 days during the year and treated 179,715 tons of hot current slag, old cold slag, and crude ore. However, only the metals recovered from fuming 83,117 tons of old slag are credited to the plant as a producer in the Smelter district. The remaining metals are credited to the individual mines producing the ore and concentrates that yielded the current hot slag for treatment in the fuming plant.

Willow Springs District.—Lessees operated the Oro Del Rey group from January 15 to November 15 and shipped 363 tons of gold-lead ore to smelters; 9 tons of gold ore were produced from the Depression mine.

UTAH COUNTY

American Fork District.—The Dutchman group was worked under lease the entire year, and 1,945 tons of zinc-lead ore were shipped to custom flotation mills; gross metal content of the ore was 56 ounces of gold, 7,798 ounces of silver, 6,938 pounds of copper, 370,798 pounds

of lead, and 775,619 pounds of zinc. From the Globe mine the Howell Mining Co. shipped to a custom mill 777 tons of zinc-lead ore containing 11 ounces of gold, 7,230 ounces of silver, 3,350 pounds of copper, 77,986 pounds of lead, and 133,223 pounds of zinc. From the Blue Rock claim 51 tons of lead ore were shipped to a smelter.

Tintic District.—Mines in the Tintic district, including those of the Utah County section, are reviewed under Juab County.

WASHINGTON COUNTY

Tutsagubet District.—E. L. Cox worked the Dixie mine from January to October and shipped 530 tons of copper ore and 308 tons of lead ore to smelters. The total ore contained 2,693 ounces of silver 181,093 pounds of copper, and 70,757 pounds of lead.

WASHINGTON
Gold, Silver, Copper, Lead, and Zinc

(MINE REPORT)

By C. E. NEEDHAM AND PAUL LUFF

GENERAL SUMMARY

IN the production of gold, silver, copper, lead, and zinc in Washington in 1946, the output of each metal declined from that in 1945. Copper made the poorest showing and slumped 22 percent in quantity, followed closely by lead, with 21 percent; gold decreased 12, silver 6, and zinc 3 percent. In spite of higher average prices for all metals except gold, the total value of the five metals declined 4 percent—from $7,140,242 in 1945 to $6,886,748 in 1946; only zinc and silver increased in value over 1945. Of the total value, zinc contributed over 40 percent, gold 26, copper 21, lead over 9, and silver 3 percent.

Chelan County remained in first place in total value of the five metals produced in 1946, and Pend Oreille County was the only other county in the State having a metal output over $1,000,000. Together the two counties produced 79 percent of the State total value in 1946, compared with 84 percent in 1945.

Labor strikes, manpower shortages, and lack of ore development were largely responsible for the downward trend in ore production. However, a few companies pushed their tonnages above the 1945 levels, among them the Pend Oreille Mines & Metals Co., the Knob Hill Mines, Inc., the Kaaba-Texas Mining Co., the Jamison-Higginbotham Mining Co., and Bonanza Mines.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices:

Prices of gold, silver, copper, lead, and zinc, 1942–46

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1942	$35.00	$0.711+	$0.121	$0.067	$0.093
1943	35.00	.711+	.130	.075	.108
1944	35.00	.711+	.135	.080	.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67 + ($20.671835) per fine ounce.

[2] Treasury buying price for newly mined silver 1942 to June 30, 1946: $0.71111111; July 1, 1946 to Dec. 31, 1946: $0.905.

[3] Yearly average weighted price of all grades of primary metal sold by producers; price includes bonus payments by the Office of Metals Reserve for overquota production.

Mine production of gold, silver, copper, lead, and zinc in Washington, 1942–46, and total, 1860–1946, in terms of recovered metals

Year	Mines producing		Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1942	37	18	1,222,937	75,396	$2,638,860	369,038	$262,427
1943	24	2	1,131,281	65,244	2,283,540	370,440	263,424
1944	25	3	1,180,662	47,277	1,654,695	321,608	228,699
1945	21	3	968,246	57,860	2,025,100	281,444	200,138
1946	16	5	858,023	51,168	1,790,880	264,453	213,678
1860–1946			(1)	2,178,670	55,008,773	12,829,873	9,109,513

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1942	16,060,000	$1,943,260	9,702,000	$650,034	28,796,000	$2,678,028	$8,172,609
1943	14,630,000	1,901,900	10,044,000	753,300	24,406,000	2,635,848	7,838,012
1944	12,338,000	1,665,630	11,650,000	932,000	23,808,000	2,714,112	7,195,136
1945	11,642,000	1,571,670	7,604,000	653,944	23,386,000	2,689,390	7,140,242
1946	9,054,000	1,466,748	5,974,000	651,166	22,658,000	2,764,276	6,886,748
1860–1946	[2] 78,926	20,700,509	[2] 75,763	10,147,024	[2] 137,815	22,378,648	117,344,467

[1] 1860–1903: Figures not available; 1904–46, 12,525,422 tons produced.
[2] Short tons.

Mine production of gold, silver, copper, lead, and zinc in Washington in 1946, by months, in terms of recovered metals

Month	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
January	5,254	21,135	1,010,000	538,000	1,748,000
February	5,436	17,045	808,000	524,000	1,962,000
March	5,425	25,746	958,000	610,000	2,162,000
April	5,052	25,323	1,030,000	588,000	1,996,000
May	4,346	21,620	898,000	566,000	2,304,000
June	4,682	23,812	908,000	404,000	2,096,000
July	4,323	25,363	822,000	242,000	1,154,000
August	3,045	22,167	888,000	232,000	1,340,000
September	4,073	24,267	796,000	546,000	2,248,000
October	4,460	24,402	714,000	610,000	2,270,000
November	2,864	17,612	214,000	608,000	1,638,000
December	2,208	15,961	8,000	506,000	1,740,000
Total: 1946	51,168	264,453	9,054,000	5,974,000	22,658,000
1945	57,860	281,444	11,642,000	7,604,000	23,386,000

Gold.—The decrease of about 6,700 ounces in the State output of recoverable gold in 1946, compared with 1945, resulted in large part from a reduced output of gold from the Holden property of the Howe Sound Co. in Chelan County; the mine, however, remained the State's leading gold producer by a wide margin. The Knob Hill mine in Ferry County was the only other important gold producer in 1946; output from this property was 7 percent greater than in 1945. These two properties supplied over 96 percent of the State total gold in 1946. Placer mining was more active in 1946 than in 1945; the quantity of gravel washed was 90 times greater than in 1945, but the quantity

of gold recovered increased only a little more than seven times. Fifty-eight percent of the State gold output in 1946 was recovered from ore treated in concentration mills and most of the remainder from current slimes cyanided.

Silver.—Silver production in Washington in 1946 remained entirely a byproduct of gold and base-metal ores. Again, the two leading silver producers were the Holden and Knob Hill mines, but in 1946 their position were reversed, Knob Hill leading by a small margin. Neither company in 1946 maintained its 1945 level of silver output. The Kaaba mine in Okanogan County ranked third and increased its silver output over 50 percent compared with 1945 output. These three properties supplied 86 percent of the State total silver in 1946.

Gold ore moved to first place as a source of silver in Washington in 1946, contributing 40 percent, and zinc-copper ore dropped to 35 percent; zinc-lead ore produced 20 percent, lead ore 5 percent, and zinc ore, copper ore, and placers together less than 0.5 percent. Of the State silver output in 1946, 57 percent was recovered from ore treated in concentration mills; 37 percent from ore, concentrates, and current slimes cyanided; and nearly all the remainder from crude ore smelted.

Copper.—Copper output in Washington in 1946 declined for the sixth consecutive year. The Holden mine in Chelan County, producing from zinc-copper ore treated by flotation, remained the only significant copper producer. In November the Holden mill closed, and all work was directed toward mine development.

Lead.—The marked decline in lead production in Washington in 1946 resulted mainly from labor strikes in the Metaline district, Pend Oreille County. The Grandview mine of the American Zinc, Lead & Smelting Co. was the leading producer, followed by the property of the Pend Oreille Mines & Metals Co., both in Pend Oreille County. The Bonanza mine in Stevens County ranked third, and the Metaline Mining & Leasing Co. was fourth. These four properties produced 88 percent of the State total lead. About 80 percent of the total lead output was derived from zinc-lead ore concentrated, and nearly all the remainder from lead ore concentrated.

Zinc.—Among the five metals in Washington in 1946, zinc made the best showing. The slight decline was due mainly to reduced production at the Holden mine and to work stoppages for 2 months caused by a labor strike at the properties of the American Zinc, Lead & Smelting Co. and the Metaline Mining & Leasing Co. Nearly 99 percent of the State zinc came from the five following properties, ranking in the order named: The Grandview mine; the property operated by the Pend Oreille Mines & Metals Co.; the Deep Creek mine of the Jamison-Higgenbotham Mining Co. in Stevens County; the Holden mine; and the property of the Metaline Mining & Leasing Co. Sixty-nine percent of the total zinc was recovered from zinc-lead ore concentrated, 16 percent from zinc ore concentrated, and 15 percent from zinc-copper ore concentrated.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Washington in 1946, by counties, in terms of recovered metals

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Asotin		1	85	$2,975	16	$13
Benton		1	1	35		
Chelan	3		32,476	1,136,660	93,968	75,926
Ferry	4		18,563	649,705	103,260	83,434
Kittitas		1	11	385	5	4
Okanogan	1		1	35	37,964	30,675
Pend Oreille	3				7,375	5,959
Snohomish	1	1	4	140	349	282
Stevens	4		24	840	21,516	17,385
Whitman		1	3	105		
Total: 1946	16	5	51,168	1,790,880	264,453	213,678
1945	21	3	57,860	2,025,100	281,444	200,138

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Asotin							$2,988
Benton							35
Chelan	8,987,000	$1,455,894			3,460,000	$422,120	3,090,600
Ferry							733,139
Kittitas							389
Okanogan	31,000	5,022	325,000	$35,425	116,500	14,213	85,370
Pend Oreille	13,000	2,106	4,448,000	484,832	15,370,500	1,875,201	2,368,098
Snohomish	16,000	2,592					3,014
Stevens	7,000	1,134	1,201,000	130,909	3,711,000	452,742	603,010
Whitman							105
Total: 1946	9,054,000	1,466,748	5,974,000	651,166	22,658,000	2,764,276	6,886,748
1945	11,642,000	1,571,670	7,604,000	653,944	23,386,000	2,689,390	7,140,242

Gold produced at placer mines in Washington, 1942–46, by classes of mines and by methods of recovery

Class and method	Mines producing	Material treated (cubic yards)	Gold recovered		
			Fine ounces	Value	Average per cubic yard
Dragline dredges:					
1942–45					
1946	1	10,000	85	$2,975	$0.298
Nonfloating washing plants: [1]					
1942	7	43,491	332	11,620	.267
1943	1	4,830	114	3,990	.826
1944	1	5,500	55	1,925	.350
1945					
1946	1	15,000	11	385	.026
Small-scale hand methods:					
1942	11	700	24	840	1.200
1943	1	40	2	70	1.750
1944	2	75	4	140	1.867
1945	3	275	14	490	1.782
1946	3	115	5	175	1.522
Grand total, placer:					
1942	18	44,191	356	12,460	.282
1943	2	4,870	116	4,060	.834
1944	3	5,575	59	2,065	.370
1945	3	275	14	490	1.782
1946	5	25,115	101	3,535	.141

[1] Includes all placer operations using power excavator and washing plant, both on dry land; an outfit with movable washing plant is termed a "dry-land dredge."

MINING INDUSTRY

Increased average prices for all metals except gold failed to halt the downward trend in ore output in Washington in 1946, and the quantity of ore produced declined 11 percent from that in 1945. Chief among the causes for the decrease were the 2-month strike, called late in June, at operations of the American Zinc, Lead & Smelting Co. and the Metaline Mining & Leasing Co.; continued labor shortages at many mines; and the closing of the Holden mill in November in preparation for a 6-month development program at the mine. During the year, the seven leading properties produced 842,186 tons of ore—98 percent of the State total—compared with 947,167 tons in 1945.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Washington in 1946, with content in terms of recovered metals

Source	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold ore	6	51,622	18,686	103,369			
Copper ore	1	43	3	349	16,000		
Lead ore	2	6,920	12	14,433	2,150	1,066,800	51,000
Zinc ore	1	39,634	6	708	4,000	78,000	3,580,000
Zinc-copper ore	1	491,402	32,353	93,859	8,987,000		3,460,000
Zinc-lead ore	5	268,402	7	51,714	44,850	4,829,200	15,567,000
Total, lode mines	16	858,023	51,067	264,432	9,054,000	5,974,000	22,658,000
Total, placers	5		101	21			
Total: 1946	21	858,023	51,168	264,453	9,054,000	5,974,000	22,658,000
1945	24	968,246	57,860	281,444	11,642,000	7,604,000	23,386,000

METALLURGIC INDUSTRY

Of the 858,023 tons of lode material from Washington mines sold or treated in 1946, 806,147 tons (94 percent) went to concentrating mills, 43,107 tons (5 percent) to a cyanidation-concentration mill, and 8,769 tons (1 percent) to smelters, compared with 94, 4, and 2 percent, respectively, in 1945.

The cyanide plant at the Holden mill at Holden operated throughout the year until November 9, except for May; 416,721 tons of current flotation tailings from zinc-copper ore were cyanided. The 400-ton cyanidation-concentration mill of Knob Hill Mines, Inc., at Republic was active throughout the year and cyanided 12,543 tons of crude ore, 28,433 tons of current flotation tailings, and 1,110 tons of flotation concentrate.

The 806,147 tons of ore treated by concentration in 1946 were distributed among eight mills as follows: One plant, 491,402 tons of zinc-copper ore; four plants, 268,043 tons of zinc-lead ore; two plants, 6,920 tons of lead ore; and one plant, 39,634 tons of zinc ore. In addition, 148 tons of zinc-lead ore were shipped to Bauer, Utah, for treatment.

Mine production of metals in Washington in 1946, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Ore, concentrates, and current slimes cyanided	458,807	19,365	99,101			
Concentrates smelted	806,147	29,881	151,984	9,037,468	5,931,400	22,621,350
Ore smelted	8,769	1,821	13,347	16,532	42,600	36,650
Placer		101	21			
Total: 1946		51,168	264,453	9,054,000	5,974,000	22,658,000
1945		57,860	281,444	11,642,000	7,604,000	23,386,000

Mine production of metals from cyanidation mills [1] (with or without concentration equipment) in Washington in 1946, by counties, in terms of recovered metals

County	Ore treated (short tons)	Recovered in bullion		Concentrates smelted and recovered metal		
		Gold (fine ounces)	Silver (fine ounces)	Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)
Chelan	(2)	[2] 2,493	[2] 3,873			
Ferry	[3] 44,217	11,265	57,204	1,021	5,607	38,024
Total: 1946	[3] 44,217	13,758	61,077	1,021	5,607	38,024
1945	[4] 33,227	5,060	27,907	2,170	10,932	81,685

[1] No amalgamation in 1945 or 1946.
[2] Material cyanided was 416,721 tons of current tailings from zinc-copper ore.
[3] Includes 1,110 tons of flotation concentrates cyanided.
[4] Includes 774 tons of flotation concentrates cyanided.

Mine production of metals from concentrating mills in Washington in 1946, by counties, in terms of recovered metals

County	Ore treated (short tons)	Concentrates smelted and recovered metal					
		Concentrates produced (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Chelan	491,402	23,868	29,860	89,986	8,987,000		3,460,000
Okanogan	20,395	425	1	37,964	31,000	325,000	116,500
Pend Oreille	247,648	17,330		7,375	13,000	4,448,000	15,370,500
Stevens	46,702	4,390	20	16,659	6,468	1,158,400	3,674,350
Total: 1946	806,147	46,013	29,881	151,984	9,037,468	5,931,400	22,621,350
1945	914,931	52,961	39,940	161,438	11,630,956	7,562,479	23,363,320

Gross metal content of concentrates produced from ores mined in Washington in 1946, by classes of concentrates smelted

Class of concentrate	Concentrates produced (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry gold	1,021	5,607	38,024			
Copper	20,027	29,588	87,326	9,166,314		1,045,400
Lead	4,409	13	59,596	31,633	5,820,140	221,305
Zinc	21,547	279	4,956	147,355	288,346	24,393,480
Iron	30	1	106	39	618	2,645
Total: 1946	47,034	35,488	190,008	9,345,341	6,109,104	25,662,830
1945	55,131	50,872	243,123	12,010,680	7,811,545	27,634,598

Mine production of metals from Washington concentrates shipped to smelters in 1946, in terms of recovered metals

BY COUNTIES

	Concentrates (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Chelan	23,868	29,860	89,986	8,987,000		3,460,000
Ferry	1,021	5,607	38,024			
Okanogan	425	1	37,964	31,000	325,000	116,500
Pend Oreille	17,330		7,375	13,000	4,448,000	15,370,500
Stevens	4,390	20	16,659	6,468	1,158,400	3,674,350
Total: 1946	47,034	35,488	190,008	9,037,468	5,931,400	22,621,350
1945	55,131	50,872	243,123	11,630,956	7,562,479	23,363,320

BY CLASSES OF CONCENTRATES

Dry gold	1,021	5,607	38,024			
Copper	20,027	29,588	87,326	8,900,150		
Lead	4,409	13	59,596	22,971	5,718,231	154,415
Zinc	21,547	279	4,956	114,314	212,669	22,466,935
Iron	30	1	106	33	500	
Total: 1946	47,034	35,488	190,008	9,037,468	5,931,400	22,621,350

Gross metal content of Washington crude ore shipped to smelters in 1946, by classes of ore

Class of ore	Ore (short tons)	Gross metal content				
		Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Dry and siliceous gold	8,515	1,814	8,141			
Copper	43	3	349	16,360		
Zinc-lead	211	4	4,857	650	43,424	45,865
Total: 1946	8,769	1,821	13,347	17,010	43,424	45,865
1945	18,692	1,914	10,414	11,351	42,226	27,768

Mine production of metals from Washington crude ore shipped to smelters in 1946, in terms of recovered metals

BY COUNTIES

	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)
Chelan	285	123	109			
Ferry	8,230	1,691	8,032			
Snohomish	43	3	349	16,000		
Stevens	211	4	4,857	532	42,600	36,650
Total: 1946	8,769	1,821	13,347	16,532	42,600	36,650
1945	18,692	1,914	10,414	11,044	41,521	22,680

BY CLASSES OF ORE

Dry and siliceous gold	8,515	1,814	8,141			
Copper	43	3	349	16,000		
Zinc	211	4	4,857	532	42,600	36,650
Total: 1946	8,769	1,821	13,347	16,532	42,600	36,650

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Washington in 1946, by counties and districts, in terms of recovered metals

County and district	Mines producing: Lode	Mines producing: Placer	Ore sold or treated (short tons)	Gold (lode and placer) (fine ounces)	Silver (lode and placer) (fine ounces)	Copper (pounds)	Lead (pounds)	Zinc (pounds)	Total value
Asotin County:									
Snake River		1		85	16				$2,988
Benton County:									
Columbia River		1		1					35
Chelan County:									
Chelan Lake	1		491,402	32,353	93,859	8,987,000		3,460,000	3,086,207
Peshastin Creek	1		90	99	52				3,507
Wenatchee River	1		195	24	57				886
Ferry County:									
Republic (Eureka)	4		51,337	18,563	103,260				733,139
Kittitas County:									
Swauk		1		11	5				389
Okanogan County:									
Loomis-Oroville	1		20,395	1	37,964	31,000	325,000	116,500	85,370
Pend Oreille County:									
Metaline	3		247,648		7,375	13,000	4,448,000	15,370,500	2,368,098
Snohomish County:									
Index	1		43	3	349	16,000			2,979
Sultan		1		1					35
Stevens County:									
Bossburg	2		4,109	8	13,568	2,500	856,000	80,000	114,712
Deer Trail	1		3,170	10	7,240	500	267,000	51,000	41,606
Northport	1		39,634	6	708	4,000	78,000	3,580,000	446,692
Whitman County:									
Snake River		1		3					105
Total Washington	16	5	858,023	51,168	264,453	9,054,000	5,974,000	22,658,000	6,886,748

ASOTIN COUNTY

Snake River District.—Clyne J. Johnson operated a dragline dredge on the Ausman claim intermittently for nine months during 1946 and washed about 10,000 cubic yards of gravel, which yielded 85 ounces of gold and 16 ounces of silver.

CHELAN COUNTY

Chelan Lake District.—The Holden mine of the Howe Sound Co. remained the leading producer of gold and copper in Washington in 1946 but dropped to second place in silver and from third to fourth place in zinc output. The mine was operated throughout the year, but the company 2,000-ton flotation mill was closed November 9. Zinc-copper ore treated declined from 617,120 tons in 1945 to 491,402 tons in 1946; gross metal content of the ore treated in 1946 was 37,700 ounces of gold, 136,700 ounces of silver, 9,750,000 pounds of copper, and 5,875,000 pounds of zinc. The mill yielded 20,027 tons of copper concentrate and 3,841 tons of zinc concentrate. In addition, 416,721 tons of current tailings were treated by cyanidation to produce gold and silver bullion. In November an extensive development program was launched at the mine to last about 6 months, during which time the mill will remain idle.

Peshastin Creek (Blewett) District.—Karl W. Fackler operated the Polepick mine in 1946 and shipped two cars of high-grade gold ore to a smelter.

Wenatchee River District.—A few cars of highly siliceous low-grade gold ore from the Gold King and MacBeth claims were shipped to a smelter early in the year, after which option on the property was surrendered by the Knob Hill Mines, Inc.

FERRY COUNTY

Republic District.—Knob Hill Mines, Inc., operated its mine throughout 1946 and produced 84 percent of the ore mined in the district; the output of ore was substantially higher than in 1945. The mine was the State's leading silver producer in 1946 and ranked second in gold. The company 400-ton flotation-cyanidation mill was operated continuously throughout the year; during the first quarter, the flotation concentrate was given special cyanidation treatment and discarded; during the second quarter, the ore was cyanided directly without flotation treatment; beginning July 1 flotation was resumed, and until November 1 the concentrate was subjected to cyanidation before shipment to a smelter; and after November 1 the concentrate without cyanidation went to a smelter. Lessees worked several claims of the Aurum group and shipped 4,541 tons of gold ore to a smelter. A car of similar ore was shipped also from the Republic group. C. M. Trevitt shipped 3,635 tons of gold ore from the South Penn mine to a smelter; the metal content was 480 ounces of gold and 2,344 ounces of silver.

KITTITAS COUNTY

Swauk Disrict.—The Mohawk Mining Co. operated a dry-land dredge on Swauk Creek during the 1946 season. The washing of about 15,000 cubic yards of gravel yielded 11 ounces of gold and 5 ounces of silver.

OKANOGAN COUNTY

Loomis-Oroville District.—The Kaaba mine of the Kaaba-Texas Mining Co. ranked third in silver output and fifth in lead among Washington producers in 1946. The company 150-ton flotation mill operated at a daily average of 98 tons during the year and treated 20,395 tons of zinc-lead ore which contained 2 ounces of gold, 40,750

ounces of silver, 80,000 pounds of copper, 530,000 pounds of lead, and 300,000 pounds of zinc.

PEND OREILLE COUNTY

Metaline District.—Output of zinc-lead ore from the Metaline district held steady in 1946 in spite of some labor difficulties, and production declined little more than 2 percent from that in 1945; despite higher prices for silver, copper, lead, and zinc, the value of metal output in 1946 decreased 1 percent from that in 1945.

In 1946 the Grandview mine of the American Zinc, Lead & Smelting Co. ranked first in output of lead and zinc among State producers, but production of ore dropped nearly 6 percent from that in 1945, largely because of a labor strike at the property from June 25 to August 26.

The Pend Oreille Mines & Metals Co. operated its Josephine, Hortense, Sullivan, and Yellowhead groups throughout the year and treated 122,106 tons of zinc-lead ore in the company 750-ton flotation mill, compared with 116,696 tons in 1945. Gross metal content of the ore was 5,000 ounces of silver, 20,000 pounds of copper, 1,680,000 pounds of lead, and 7,400,000 pounds of zinc.

Operations of the Metaline Mining & Leasing Co. were hampered during the year by a labor strike, which closed the company mine from June 25 to August 26, and ore production declined over 8 percent from 1945. Among State producers in 1946, the property ranked fourth in lead production and fifth in zinc.

SNOHOMISH COUNTY

Index District.—The Index Mining Co. conducted exploration on the Sunset claim during the year and shipped a car of copper ore to a smelter.

STEVENS COUNTY

Bossburg District.—Bonanza Lead operated its Bonanza mine and 100-ton flotation mill throughout the year. The property ranked third among State lead producers. Morris & Leighton, lessees, operated the Young America mine about 150 days in 1946 and produced a total of 359 tons of zinc-lead ore. Of this quantity 211 tons, containing 4 ounces of gold, 4,857 ounces of silver, 650 pounds of copper, 43,424 pounds of lead, and 45,865 pounds of zinc, were shipped to a smelter; the remaining 148 tons treated at Bauer, Utah, contained 5 ounces of gold, 1,793 ounces of silver, 481 pounds of copper, 16,431 pounds of lead, and 58,232 pounds of zinc.

Deer Trail District.—Zenith Mines, Inc., lessee, mined a substantial quantity of lead ore from the Cleveland mine, which yielded several cars of lead concentrate and a car of zinc concentrate. The property ranked sixth among State lead producers in 1946.

Northport District.—The Jamison-Higginbotham Mining Co., worked its Deep Creek mine and produced 39,634 tons of zinc ore in 1946, an increase of more than 10,000 tons over its 1945 output. The ore was treated in the Sierra Zinc Co. Blue Ridge flotation mill on Deep Creek. The zinc concentrate produced (3,295 tons) contained 6 ounces of gold, 708 ounces of silver, 4,111 pounds of copper, 81,242 pounds of lead, and 4,000,000 pounds of zinc. The property ranked third among State zinc producers in 1946.

Wyoming
Gold, Silver, Copper, and Lead

(MINE REPORT)

By S. A. GUSTAVSON

GENERAL SUMMARY

IN Wyoming, intermittent operation of three lode and two placer mines accounted for all the 1946 production of gold, silver, and copper; the total value was $4,020. No recoverable lead or zinc was mined. The total production in 1945 of gold, silver, and lead was valued at $608. In 1946, 105 ounces of gold, 26 ounces of silver, and 2,000 pounds of copper were recovered from mining operations, compared with 2 ounces of gold, 31 ounces of silver, and 6,000 pounds of lead in 1945.

A summary of the past production of Wyoming shows that the State has produced gold, silver, copper, and lead having a total value of $7,577,418 during the period 1867 to 1946, inclusive. Gold and silver have been produced from many localities throughout the State, whereas the output of copper (most of which was mined prior to 1924 and which represents over three-fourths of the total recorded value of the four metals) has come from the Encampment district, in Carbon County; the Hartville district, originally in Laramie County, now in Platte County; and the Laramie district, in Albany County. All the lead produced in the State came from the Spring Creek district, in Carbon County; the Hurricane district, in Crook County; and the Douglas Creek district, in Albany County; it was mined during 1932, 1934, 1935, 1942, and 1945.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

The value of the metal production herein reported has been calculated at the following prices.

Prices of gold, silver, copper, lead, and zinc, 1942–46

Year	Gold[1]	Silver[2]	Copper[3]	Lead[3]	Zinc[3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1942	$35.00	$0.711+	$0.121	$0.067	$0.093
1943	35.00	.711+	.130	.075	.108
1944	35.00	.711+	.135	.080	.114
1945	35.00	.711+	.135	.086	.115
1946	35.00	.808	.162	.109	.122

[1] Price under authority of Gold Reserve Act of Jan. 31, 1934. Treasury legal coinage value of gold from Jan. 18, 1837, to Jan. 31, 1934, was $20.67+($20.671835) per fine ounce.

[2] Treasury buying price for newly mined silver. 1942 to June 30, 1946: $0.71111111; July 1, 1946, to Dec. 31, 1946: $0.905.

[3] Yearly average weighted price of all grades of primary metal sold by producers; price includes bonus payments by Office of Metals Reserve for overquota production.

MINE PRODUCTION

The following table shows the annual output of ore from lode mines producing gold, silver, copper, and lead and the quantity and value of the metals recovered from both lode and placer mines in Wyoming from 1942 to 1946; it also gives the total production of metals from 1867 to 1946.

Mine production of gold, silver, copper, and lead in Wyoming, 1942–46, and total, 1867–1946, in terms of recovered metals

Year	Ore (short tons)	Gold (lode and placer)		Silver (lode and placer)		Copper		Lead		Total value
		Fine ounces	Value	Fine ounces	Value	Pounds	Value	Pounds	Value	
1942	84	23	$805	52	$37			6,000	$402	$1,244
1943										
1944	6	20	700	3	2					702
1945	52	2	70	31	22			6,000	516	608
1946	61	105	3,675	26	21	[1] 2,000	$324			4,020
1867–1946	(2)	78,041	1,839,763	74,692	51,797	[3] 16,326	5,684,372	[3] 14	1,486	7,577,418

[1] Includes less than ½ ton of recoverable copper produced in 1945 from the Bartlett (Copper King) mine in Laramie County.
[2] Figure not available.
[3] Short tons.

REVIEW BY COUNTIES

ALBANY COUNTY

One lode and two placer mines operated in Albany County in 1946. The Silver King Mining Co. made a test shipment of 19 tons of copper ore from the Silver King mine in sec. 20, T. 16 N., R. 72 W. (a few miles east of Laramie). The ore contained 0.4 ounce of gold, 10 ounces of silver, and 1,027 pounds of copper. The Medicine Bow Mining Co. operated a dragline excavator and dry-land washing plant on the McClellan and F & M claims on Douglas, Muddy, Lake, Jim, and Willow Creeks, all situated in the Douglas Creek district. The plant was operated from June to October and washed about 8,000 cubic yards of gravel, which yielded 14 ounces of gold and 3 ounces of silver. About 3 ounces of gold were recovered from small hand operations at the Triangle placer on Beaver Creek.

FREMONT COUNTY

Two lode mines, both in the Atlantic City and South Pass district, were operated in Fremont County in 1946. J. E. Vanderwalker & Co. operated the Duncan mine during September and produced 17 tons of ore containing 83 ounces of gold and 12 ounces of silver. J. Don Birch and Rex Birch treated by amalgamation 25 tons of ore from the Mary B mine in the Lemlie mill, recovering about 5 ounces of gold and 1 ounce of silver. The Mica Mountain Mines, Inc., made preparations at the Carissa mine and mill to begin mining operations in 1947.

PART IV. FOREIGN REVIEWS

The Mineral Industry of

Middle and South America[1]

By SUMNER M. ANDERSON

	PAGE
General summary	1561
Middle America	1562
West Indies:	
British West Indies	1562
Bahamas	1562
Barbados	1562
Bermuda	1562
Jamaica and dependencies	
Trinidad	1563
Cuba	1563
Dominican Republic	1567
Haiti	1567
Netherlands West Indies	1568
Mexico	1568
Central America:	
British Honduras	1575
Costa Rica	1575
El Salvador	1576
Guatemala	1577
Honduras	1578
Nicaragua	1579
Panama	1579
South America	1580
Argentina	1580
Bolivia	1581
Brazil	1584
British Guiana	1590
Chile	1591
Colombia	1593
Ecuador	1595
French Guiana	1596
Paraguay	1596
Peru	1596
Surinam	1600
Uruguay	1601
Venezuela	1602

GENERAL SUMMARY[2]

MINING in the Western Hemisphere south of the United States, as in the rest of the world, encountered many retarding obstacles in 1946 in adjusting to postwar conditions. Production of about one-third of the principal metals in 1946 increased, but only two of the large-tonnage ores—bauxite and iron ore—were included in this group. The scarcity and increased cost of labor, strikes and other manifestations of social unrest, high rates of taxation, burdensome legislation, and continued scarcity of machinery and supplies combined to nullify, in most mining operations, the incentive offered by favorable demand and prices.

Production of nonmetallic minerals responded better in general to increased demand where such demand was predominantly local rather than international, and in particular to the favorable world market for diamonds and Chilean nitrates.

[1] Reviews of the mineral industries in Canada, Newfoundland, and the Eastern Hemisphere cannot be presented in Minerals Yearbook, 1946 (except in part in various commodity chapters), as a result of reduction in staff.

[2] The tonnage unit used in this chapter is the metric ton.

A few discrepancies exist between the foreign statistics in some of the commodity chapters and the statistics presented in this chapter inasmuch as the latter are based on new and revised information received from abroad, subsequent to the preparation of the commodity chapters.

Outstanding success was attained in improving the output of hydrocarbons. Increased coal production by Mexico, Peru, and possibly Colombia more than offset decreases in Brazil and Chile. A slight recession in the crude petroleum yields of Argentina, Colombia, Peru, Ecuador, Brazil, and Trinidad was overshadowed by the enormous increase in Venezuela and the lesser but substantial gain in Mexico. Increased output of refinery products was recorded from 8 of the 10 countries that have refining facilities.

MIDDLE AMERICA

BRITISH WEST INDIES

Mineral production in the British West Indies is confined to asphalt and petroleum, limestone and lime, construction stone (including sand and gravel), and salt.

Bahamas.—Extraction of salt from sea water by West India Chemicals, Ltd., which amounted to 60,960 tons in 1944 and 38,825 tons in 1945, and the production of limestone have not been reported for 1946.

Petroleum exploration was active throughout 1946, but production has not yet been attained. Concessions totaling 47,399 square miles of land and off-shore waters have been granted to seven companies and extensive exploration is under way by use of gravity, seismic, and magnetic survey methods. The first test well, started on April 24, 1946, on Andros Island reached a depth of 12,440 feet by the end of the year.

Barbados.—Quantities of limestone, sandstone, sand, and earth produced locally for domestic consumption have not been reported for 1946. Production of the variety of natural asphalt known as manjak has been dwindling for several years and was insignificant in 1946. The British Union Oil Co. bails small quantities of crude petroleum from shallow wells for local refining and use. Production amounted to 1,738 barrels in 1945 and 1,278 barrels in 1946. About 7 million cubic feet of natural gas a year come from the same field.

Bermuda.—Bermuda is reported to quarry about 75,000 tons of limestone a year, of which roughly 22,000 tons is burned to yield some 12,500 tons of lime, and the remainder is used in construction and road building.

Jamaica.—Limestone and lime are produced in Jamaica in unreported amounts.

The potential success of bauxite mining offers one of the few prospects for the island's economic rehabilitation. Sample shipments were made in 1946, and both the Reynolds Metals Co. and Jamaica Bauxites, Ltd. (Aluminum Co. of Canada) continued postponement of commercial development of their concessions pending long-delayed adoption of a mining code for Jamaica.[3] Intensive prospecting of the dauxite deposits was begun in 1942 and discontinued in 1946.

Turks and Caicos Islands (Jamaica Dependencies).—Increase in production of salt from 21,229 tons in 1945 to 31,571 in 1946 represented recovery from most of the destruction of salinas and Govern-

[3] Appropriate mining legislation was drafted in the Colonial Office and passed by the Legislature on August 22, 1947.

ment-owned stocks by the hurricane of September 1945. Production and export of salt is the only important industry of the island group.

Trinidad.—Limestone production rose 8 percent from 617,350 tons in 1945 to 667,000 tons in 1946. Asphalt production (Trinidad Lake) more than tripled from 29,462 tons in 1945 to 92,160 tons in 1946, exceeding the output of 81,753 tons in 1941. Production of crude petroleum [4] dropped 4 percent from 21,092,603 barrels in 1945 to 20,232,941 barrels in 1946, the output of 1820 wells in 14 fields. The decrease, accompanied by an increase in total footage drilled and in average number of producing wells, marks a general weakening in the productivity of the known fields of the island, and has stimulated interest in the discovery of new reserves. Particular attention has been directed to the extension of the producing area westward into the Gulf of Paria, where three seismographic crews were engaged in geophysical surveying by early 1947.

Of Trinidad's seven refineries, the five smallest are shut down. The two remaining large plants of Trinidad Leaseholds, Ltd., at Pointe à Pierre and United British Oilfields at Point Fortin exported 20,651,037 barrels of refinery products in 1945 and 20,431,747 barrels in 1946.

CUBA

Outstanding events in the Cuban minerals industries in 1946 were the closing of the Cuban Mining Co. manganese nodulizing plant at the end of the year, the initiation of chemical-grade manganese ore production on a commercial scale, the intention of the Nicaro Nickel Co. to cease operating its nickel oxide plant early in 1947, and the renewal of gold mining on the Isle of Pines. Output in 1945–46 is presented in the accompanying table.

METALLIC ORES AND CONCENTRATES

Chromite.—Although the production of refractory-grade chromite declined during the latter half of the year, total output compared favorably with that of 1945 and may be expected to be sustained at about the same level in 1947. Principal producers were Cía. Minera Moa, S. A., Cía. Cubana de Minas y Minerales, S. A., and the Juragua Iron Co. The Narciso and Cromita mines of Primativo del Portal produced in the first three quarters of the year only.

Miranda-Gasset and Landa y Asencio were closed down throughout 1946, leaving the Mayari Mining Co., S. A., the sole producer of metallurgical-grade chromite; output was from its Caledonia mine, Province of Oriente. Three-fourths of the ore was mined in the latter half of the year, following conclusion of satisfactory price agreements.

Copper.—As anticipated last year, the development of newly found reserves at Minas de Matahambre, S. A., boosted 1946 production to the position of the best copper year since 1938, and further improvement is expected in 1947. The Matahambre mine is the only copper property operating in the Republic; and considerations of reopening the old Candida, Dora, and Francisco mines—also in the Province of Pinar del Rio—were abandoned early in 1946 following geological investigations that yielded discouraging results. Arozena y Suarez

[4] For a more detailed review, see The Oil Weekly, 1947 World Oil Atlas, June 30, 1947, pp. 213, 215.

Mineral production of Cuba, 1945–46, in metric tons (unless otherwise indicated)

Mineral	1945	1946	Change, percent
METALLIC ORES AND CONCENTRATES			
Chromite:			
Refractory grade [1]	161,612	169,763	+5
Metallurgical grade [2]	11,014	4,407	−60
Total chromite	172,626	174,170	+1
Copper, in concentrates	9,067	11,321	+25
Gold, in concentrates, troy ounces	423	1,105	+161
Manganese ore:			
Metallurgical, crude, 45 percent Mn	65,677	35,617	−46
Metallurgical, sintered nodules [3]	132,316	89,537	−33
Total metallurgical grade	197,993	125,154	−37
Chemical grade [4]	254	5,604	
Total manganese ore	198,247	130,758	−34
Nickel:			
Ore, 1.43 percent Ni	(5)	1,254,590	(5)
Oxide, 77 percent Ni	14,153	14,551	+3
Nickel (plus cobalt) content	10,940	11,241	+3
Silver, in concentrates, troy ounces	107,195	127,222	+19
Tungsten concentrates, 60 percent WO_3 equivalent	9		−100
NONMETALLIC MINERALS			
Barite	2,094		−100
Cement	180,753	240,406	+33
Gypsum, crude (estimated)	10,400	14,300	+38
Gypsum, calcined	2,974	4,344	+46
Salt	63,504	58,967	−7
HYDROCARBONS			
Asphalt:			
Gilsonite	[6] 9,070	1,827	−80
Other natural (estimated)	(5)	254	(5)
Total (estimated)	(5)	2,081	(5)
Petroleum (estimated):			
Naphtha (Motembo field), barrels (42 gallons)	55,900	68,200	+22
Gas oil (Jarahueca field), do	87,600	200,200	+129
Total, do	143,500	268,400	+87

[1] 1945—32 percent Cr_2O_3; 1946—34.48 percent Cr_2O_3.
[2] 1945—45 percent Cr_2O_3; 1946—45.93 percent Cr_2O_3.
[3] 1945—49.67 percent Mn; 1946—48.39 percent Mn.
[4] 51.5 percent Mn (81.5 percent MnO_2); 1945—trial shipment; 1946—first commercial production.
[5] Figure not available.
[6] Estimated.

Somoano, S. L., plans to reopen the Mercedes mine near Guane, Pinar del Rio Province, and construction of a new copper concentrating mill is reported to be nearing completion.

Iron.—Exports of 103,854 metric tons of iron ore from Cuba in 1946 were entirely from accumulated stocks of the Juragua Iron Co., which has mined no iron ore since 1944.

Manganese.—The Charco Redondo mine of Marsden Leeder was the sole producer of direct-shipping metallurgical-grade manganese ore in 1946, the high cost of operation and transportation having eliminated the small producers that were active during World War II. Output of Charco Redondo was interrupted by flooding from November 1 to December 12; but pumps have now been installed which, reportedly, will prevent any further shut-down from this cause.

With a 32-percent drop from 1945, the year 1946 apparently marks the end of Cuban production of manganese nodules. The sintering plant of the Cuban Mining Co. at Cristo, Oriente Province, was shut down permanently on December 31 because of exhaustion of suitable

ore from the company Quinto and Ponupo mines. The sugar industry is expected to absorb most of the 426 workmen.

Following a trial shipment of 254 metric tons of chemical-grade manganese ore in 1945, production on a commercial scale was initiated in the second quarter of 1946 and was proceeding at the rate of about 750 tons a month by the end of the year. The tonnage was supplied by 18 mines. Continued demand for this grade of ore throughout 1947 is hoped for but not assured.

The future output of manganese ore by Cuba will be greatly reduced by exhaustion of ores suitable for sintering, and less than 50,000 tons a year may well come to be regarded as normal.

Nickel.—Although the United States Government-sponsored plant of the Nicaro Nickel Co. at Nicaro, on the peninsula of Lengua de Pajaro, Oriente Province, produced more nickel oxide in 1946 than at any time since operation was begun in 1943, it encountered several mechanical and technical difficulties and fell considerably short of attaining its rated annual capacity of 14,515 metric tons (16,000 short tons) of contained nickel. The Nicaro contract with the Reconstruction Finance Corporation expired December 31, 1946, but was extended to March 31, 1947, when the plant was closed and offered for sale. Performance of the plant failed to demonstrate ability to operate at a profit on a competitive basis.

Precious Metals and Byproducts.—Since 1941, when the Delita mine on the Isle of Pines and the Nueva Potosí mine in the Province of Oriente closed down, gold and silver production has been confined chiefly to the amounts contained in copper concentrates from the Matahambre mine. Early in 1946 the Delita mine, about 8 miles southwest of Santa Barbara, was reopened by the Cia. Minera de Isla de Pinos, and in the second quarter the mill produced its first concentrates from complex sulfide ore. By the end of the year 2,812 tons of ore had yielded 133 tons of concentrates containing 1,105 ounces of gold, 4,745 ounces of silver, 5.4 tons of lead, some zinc, and minor quantities of arsenic, antimony, and copper. The 34,696 tons of copper concentrates milled at Matahambre contained an additional 122,477 ounces of silver, with no gold reported.

Tungsten.—The tungsten-concentrating plant of the Corporación Pan America de Tungsteno, S. A., 30 miles southwest of Nueva Gerono on the Isle of Pines, remained shut down throughout 1946 and was offered for sale. There is little likelihood that it will be operated in 1947.

NONMETALLIC MINERALS

Barite.—Since completion of a contract with the United States Commercial Company in 1945, production of barite by Mineral Products Corp. from its quarry at Amelia has been suspended.

Diamonds.—Cuba, which produces no diamonds, in 1946 experienced a sharp set-back in its war-born diamond-cutting industry. Started in 1942, the industry reached optimum development in 1945, with 52 factories employing 3,500 workers and producing a weekly average of 1,800 carats of cut and polished diamonds. By the end of 1946 the number of operating factories had been reduced to 13, employing approximately 600 workers who cut and polished a weekly average of 500 carats of diamonds. This decline was caused by re-

current wage conflicts and the abrupt drop in prices and demand in the New York luxury market during the second half of the year. Continued recession of the industry is expected in 1947.

Salt.—Salt production by the evaporation of sea water at Sagua la Grande, Las Villas, and Caimanera, Oriente, amounted to more than 100,000 tons annually in the prewar years but declined during the war to a low of 15,422 tons in 1944 because of distribution difficulties brought about by the scarcity and rationing of fuel and gas oil. Output in 1945 and 1946 progressed along the road to industrial recovery.

Other Nonmetallic Minerals.—Estimated production of cut marble rose from 1,000 cubic feet in 1945 to 6,350 cubic feet in 1946, while crushed rock for road building and construction increased in the same period from roughly 1,590,000 to 2,385,000 metric tons. The quantitative production of lime, sand, gravel, clay, and pigment earths is not reported, although the industries are active. Magnesite production has been dormant since 1944 and is not likely to revive in the near future.

HYDROCARBONS

Asphalt.—Reports of asphalt production in Cuba in past years have been difficult to interpret because of their failure to differentiate between types. Gilsonite [5] is chiefly exported, and two other less intensely metamorphosed types of asphalt were widely used as substitute fuel while war conditions imposed restrictions on fuel imports. The clarified statistics for 1946 indicate that the domestic use of asphalt for fuel has subsided greatly from the war years, and that gilsonite production was far below normal. Cía. Exploradora de Asfalto, S. A., engaged in a drilling program to determine total asphalt deposits in Mariel, Province of Pinar del Rio, but before the end of the year abandoned plans to manufacture asphalt products.

Petroleum.—Elimination of naphtha-distribution controls at the beginning of 1946, while strict rationing of gasoline sales was maintained until July 1, stimulated activity in the Motembo field in the first half of the year and resulted in a marked increase in the year's total production over that of 1945; but the output trend was abruptly downward during the last 6 months, and the field is believed to be approaching exhaustion.

The production trend of natural-gas oil from the Jarahueca field has been sharply upward since the field was opened October 16, 1943, with 3,825 barrels in 1943, 14,831 barrels in 1944, 87,600 barrels in 1945, and 200,200 barrels in 1946. Additional refining facilities are contemplated to meet an expected further increase in production in 1947.

Several large foreign oil companies have made and are making important geological and geophysical studies elsewhere in Cuba, and three of them have engaged in test drilling. Results have been encouraging, but not yet productive.

[5] The word "gilsonite" is here applied as a term accepted commercially to describe material that technically has been classified as grahamite.

DOMINICAN REPUBLIC

Gold.—Gold continued to be washed by hand methods in the Province of Seybo and elsewhere, without any big strikes having been reported. Nominal production amounted to only 646 ounces in 1946 (486 ounces in 1945) but will doubtless continue so long as the native people engaged in this type of mining can make a daily wage of 60 to 80 cents.

Bauxite.—About midyear the Alcoa Exploration Co. completed testing the Barahona bauxite concession obtained from the Government on April 2, 1945, and withdrew from the area. The company had until May 1947 to specify whether it desired to retain contractual rights, the exercise of which would involve construction of at least 15 miles of transportation facilities to the nearest coastal outlet. The Reynolds Metals Co. withdrew from similar exploration in 1944.

Gypsum.—The gypsum mines 25 miles north of Barahona, to which port they are connected by narrow-gage railway, were taken over on January 12 from the now-defunct Cía. Salinera Dominicana, C. por A., by the Banco Agrícola e Hipotecario, which will operate them under exclusive arrangements with the Government. Output of the mines rose from 3,258 metric tons in 1945 to a record 10,974 tons in 1946; the entire tonnage was exported.

Salt.—On January 12, 1946, the salt concession of Cía. Salinera Dominicana, C. por A., was taken over by the Banco Agrícola e Hipotecario. Production during the year was an estimated 2,590 tons from the Barahona mines and 13,160 tons from the evaporation of sea water—a total of approximately 15,750 tons compared with 15,100 tons in 1945.

Petroleum.—Cía. Seaboard de Petroleo, C. por A. (Standard Oil Co. of New Jersey), test-drilled in the Provinces of Barahona and Azua. The exploration program, started in June 1939, has yet to prove the presence of petroleum in commercial quantity.

HAITI

Gold.—Small-scale gold production continued to diminish from 432 troy ounces in 1942 to 73 ounces (United States imports from Haiti) in 1945 and only 41 ounces in 1946.

Bauxite.—The Reynolds Mining Co. failed to engage in active commercial exploitation of its bauxite deposits in the Ste. Croix area after August 4, as called for in its contract with the Haitian Government, but continued construction of an access road from its concession to the coast and conducted surveys for an aerial tramway and harbor facilities in the vicinity of Miragoane. During the year several hundred additional tons of bauxite were shipped to the United States for experimental work, but the inauguration of commercial exploitation has been postponed subject to whatever terms of extension time may be granted by the Haitian Government.

Building Material.—Quantitative production of the small local limestone and lime, construction-stone, and brick industries is not regularly reported.

Salt.—The amount of crude salt recovered from sea water was not reported for 1946 but is presumed to have been adequate to meet the usual local demand for about 8,000 metric tons annually.

Petroleum.—The Cul-de-Sac test well of the Atlantic Refining Co. reached a depth of approximately 6,500 feet by the end of the year without positive results.

NETHERLANDS WEST INDIES

Gold.—Gold was produced on a small scale on the island of Aruba from 1824 until the late 1920's, when the oil-refining industry absorbed all the cheap labor. Mining interest revived in 1945 when a Canadian group obtained concessions on favorable terms and formed Aruba Combined Goldfield, Ltd., capitalized at $5,000,000. The company started exploratory test drilling on September 15, 1946.

Phosphate.—Phosphate mining at Newport, Curaçao, which was suspended during the last half of 1945, apparently was revived vigorously in 1946, as exports of 73,594 tons were recorded compared with only 8,770 tons in 1945 and 7,813 tons in 1944.

Salt.—Shipments of marine salt from salinas on the islands of Bonaire, St. Martin, and St. Eustace, totaled 3,109 tons in 1945. Production of 2,017 tons in 1946 was from Bonaire only.

Petroleum.—Crude petroleum imported for treatment in the great refineries of Aruba and Curaçao amounted to a combined total of 206,505 thousand barrels in 1945 and 231,485 thousand barrels in 1946. Of the 1945 total 1,472 thousand barrels came from Colombia; the remainder in 1945 and all of the crude treated in 1946 was of Venezuelan origin. Refinery products derived from these crudes were exported in quantities amounting to 205,731 thousand barrels in 1945 and 225,324 thousand barrels in 1946. Aruba shipped 126,038 thousand barrels of the 1946 total and Curaçao 99,286 thousand barrels. Compared with 1945, imports of crude petroleum rose 12 percent in 1946 and exports of refinery products increased 10 percent.

MEXICO

Virtually all mines except copper were on strike during most of the first quarter of 1946, accounting for the substantial reduction in output of minerals other than fuels for the year, and comparison of the latter half of 1945 with the equivalent period in 1946 shows that the general trend of mining is definitely downward. Policies of taxation, labor, and social legislation are intimately interwoven with this trend. Some hope for improvement may be seen in the fact that during the year Mexican authorities rebated the export tax to one large mining company conditional upon the company using an equivalent sum for exploration, and the result was discovery of new ore bodies; it is too early, however, to interpret this incident as marking the beginning of a new policy.

Comparison of mineral production and exports in 1945 and 1946 is presented in the accompanying table.

Mineral production and exports of Mexico, 1945–46, in metric tons (unless otherwise indicated) [1]

Mineral	Production			Exports		
	1945	1946	Change, percent	1945	1946	Change, percent
METALLIC ORES AND METALS						
Antimony (metal content)	8,754	6,572	−25	8,005	5,906	−26
Arsenic oxide (white arsenic)	15,013	9,648	−36	14,480	9,357	−35
Bismuth, in impure bars kilograms	[2] 161,368	[2] 76,139	−53	161,368	76,139	−53
Cadmium:						
In zinc concentrates exported [3] kilograms	[2] 1,195,794	[2] 686,160	−43	1,195,794	686,160	−43
In flue dust do	[2] 1,052,766	[2] 717,188	−32	1,052,766	717,188	−32
Total, cadmium mine basis [3] kilograms	[2] 2,248,560	[2] 1,403,348	−38	2,248,560	1,403,348	−38
Copper	61,680	61,054	(4)	59,910	49,548	−17
Gold troy ounces	499,301	420,500	−16	116,482	66,584	−43
Iron ore	[5] 282,524	[5] 275,445	−3	33,142	2,746	−92
Iron content	175,165	170,775	−3	[5] 20,548	[5] 1,703	−92
Iron, pig	218,322	282,243	+29	(6)	(6)	(7)
Lead (metal content)	205,315	140,143	−32	182,541	167,859	−8
Manganese ore	[2] 51,959	[2] 25,000	−52	51,959	25,000	−52
Manganese content	[2] 18,542	[2] 11,342	−39	18,542	11,342	−39
Mercury 76-pound flasks	16,443	11,661	−29	14,698	11,632	−21
Molybdenum concentrates, MoS_2 content	781	1,364	+75	773	1,361	+76
Silver troy ounces	61,097,727	43,263,132	−29	22,685,081	37,253,804	+64
Tin	177	267	+51	11	72	(8)
Tungsten concentrates, 60-percent WO_3 equivalent	[2] 134	[2] 99	−26	134	99	−26
Zinc (metal content)	209,940	139,535	−34	203,285	130,198	−36
NONMETALLIC MINERALS						
Cement (estimate)	900,800	1,072,500	+19	(6)	(6)	(7)
Fluorspar	[3] 52,400	[3] 22,260	−58	50,251	20,114	−60
Graphite	(6)	(6)	(7)	23,634	21,949	−7
Mica	(6)	(6)	(7)	409	81	−20
Strontium concentrates (celestite)	[2] 2,084	[2] 1,639	−21	2,084	1,639	−21
Sulfur	[9] 42,691	(6)	(7)	3,081	1,254	−59
HYDROCARBONS						
Coal	909,295	977,330	+7	325	3,927	(8)
Petroleum, crude barrels	43,547,360	49,235,421	+13	2,431,743	3,301,991	+36
Petroleum refinery products barrels	38,614,172	41,307,772	+7	5,479,900	6,104,371	+11

[1] Other minerals and mineral products known to be produced but in quantities that have not been reported include selenium, tellurium, vanadium, chalk, clay, gypsum (raw and calcined), lime, limestone, building and ornamental stone, salt, sodium carbonate, talc, and diatomaceous earth.
[2] Approximate production, based on exports.
[3] Estimate.
[4] Less than 0.5 percent.
[5] Calculated on basis of ore containing 62 percent iron.
[6] Not reported.
[7] Figure not available.
[8] Over 500 percent.
[9] Crude, 15–20 percent sulfur.

METALS

Antimony.—While production of antimony in Mexico declined 25 percent in 1946 compared with the preceding year, that of Bolivia increased 26 percent, and Mexico relinquished again to Bolivia the position of world's largest producer, which it had held throughout 1944 and 1945. San Luis Potosí, Oaxaca, Querétaro, and Sonora were probably the largest producers in 1946, with Chicahuaxtla,

Oaxaca, the most important single district. Production in 1946 included 693 tons of refined and impure bars and an additional 5,879 tons of antimony in ores and concentrates.

Arsenic.—Production of white arsenic in 1946 followed the downward trend in lead-zinc ores, of which it is principally a byproduct. White arsenic is recovered by direct smelting at the San Luis Potosí plant of Cía. Minera Asarco, S. A. (American Smelting & Refining Co.), and also from its own flue dust. Arsenic is also recovered from flue dust at the Torreon, Coahuila, plant of Cía. Minera de Peñoles, S. A. (American Metal Co.). The largest producers of arsenical ores are the lead-zinc-silver mines of Santa María de la Paz y Anexas, S. A., at San Luis Potosí, and the lead-silver-gold mines shipping to Peñoles from Velardeña, Durango.

Bismuth.—The recovery of bismuth in impure bars at the Monterrey plant of American Smelting & Refining Co. is essential to the purification of lead, though hardly a profitable operation. Production in 1946, as measured by exports, followed the downward trend of refined lead; exports were to the United States.

Cadmium.—Mexico is second only to the United States in world production of cadmium. Official statistics show only that portion recovered in flue dust, while much of the metal refined in the United States is taken from Mexican zinc concentrates averaging close to 0.3 percent cadmium. The 38-percent decrease in calculated cadmium exports followed closely the 36-percent decrease in zinc exports from 1945 to 1946, but the 32-percent decrease in cadmium flue dust does not appear compatible with the decrease of only 14 percent in slab zinc production. The American Smelting & Refining Co. is the only producer of cadmium flue dust, which is shipped to its plant in Denver, Colo., for reduction to metal.

Copper.—Copper production was slightly less than in 1945, but was well upheld relative to most other metals because the strike that affected most mines during the first quarter was not applied against the Cananea Consolidated Copper Co., which operated Mexico's largest copper project at Cananea, Sonora, throughout the year. Of the total production, 52,371 tons were in refined and semi-refined forms. Heavy consumption and demand, accompanied by advancing prices in the latter half of the year and complete removal of price control on November 10, stimulated a sharp upward trend in production in the United States but failed to produce a similar reaction in Mexico, indicating something of the strength of economic factors other than demand and price as applied to Mexican mining. Some response to advanced prices, however, should be evidenced in 1947, particularly among such marginal enterprises as the Boleo mine at Santa Rosalia, Baja California.

A small electrolytic copper refinery in Mexico, D. F., built in 1946 by Cobre de Mexico, S. A., encountered certain technical and other difficulties and has not yet started production.

Gold and Silver.—Precious metal production, which has declined steadily since 1942, dropped proportionate to the 1946 drop in precious-metal ores and that part of base-metal ores which carried precious-metal values.

Mexico is second only to Colombia among Latin American gold producers. The Real del Monte silver-gold mine of Cía. de Real del

Monte y Pachuca, in Hidalgo, was the leading producer, as it has been for many years. The Government extended financial aid to the cooperative working the Dos Estrellas, La Esperanza, and El Oro gold mines at El Oro, Michoacán, and turned its problems over to the Comisión de Fomento Minero for possible solution; difficulties in this area may have an adverse effect on total production in 1947. The Moctezuma mine, Moctezuma, Sonora, was leased to Cía. Minerales de Nacozari, a new company which intends to install machinery to handle low-grade ore.

Despite the drop in silver output, Mexico's position as the world's largest producer was not threatened in 1946. The Real del Monte mine at Pachuca was still the country's largest single producer, but the greater part of total output came from base-metal ores. Several factors contribute to the notable observation that price fluctuations have had little or no effect on silver production: (1) Straight silver and gold-silver producers are working at plant capacities which cannot be expanded, regardless of price, without heavy expenditures that are not warranted under present economic conditions; (2) byproduct output of silver is influenced more by base-metal prices than by silver prices; (3) little or none of the benefits of increased silver prices accrue to the mine operators—they are absorbed by taxes and by advanced wages which fail, however, to follow price recessions. The straight-precious-metal producers are facing a serious labor problem, and many of them will be unable to continue operations if costs are further increased. The Dos Carlos cooperative silver-gold mine at Pachuca was saved, at least temporarily, only by financial aid from the Government; and the historic Guanajuato district is approaching abandonment, with large tonnages of low-grade ore, workable under more favorable conditions, remaining in the ground.

The Santo Domingo copper-silver-gold-lead mine at Pilares de Nacozari, Sonora, was leased to Haile Mines, Inc., of New York. Operations are expected to start in 1947.

Iron and Steel.—Iron-ore production, which has decreased somewhat since 1944, was chiefly limited in 1946 by the availability of metallurgical coke. Ample reserves of high-grade ore exist at Cerro de Mercado near Durango in eastern Chihuahua and elsewhere; preliminary investigations of Las Truchas deposits in Michoacán by Bethlehem Steel Co. were abandoned early in the year, and plans of others for opening La Perla and La Negra iron deposits in eastern Chihuahua are, for the time being, in abeyance.

An apparent discrepancy is presented in official figures which indicate a 1944–45 drop of 6 percent and a 1945–46 drop of 3 percent in iron-ore production compared with a 62-percent and a 29-percent rise in pig-iron production during the same periods. Output is from two blast furnaces of Cía. Fundidora de Fierro y Acero de Monterrey, S. A., at Monterrey and one of Altos Hornos de Mexico at Monclova, Coahuila.

Steel-making capacity falls far short of meeting the requirements of the country. Steel is produced by Cía. Fundidora and Altos Hornos, principally from pig smelted in their own furnaces, and by La Consolidada, S. A., from domestic and imported scrap with some additions of local pig iron. If a plan for increasing coal production in the Sabinas area materializes, it should relieve the extreme shortage

of coke and proportionately relieve the limitation on pig-iron and steel putput. The coke-making capacity of existing beehive ovens is ample to feed present smelting capacities. Steel remelt and processing capacity is expanding moderately: La Consolidada added a new furnace to its plant at Mexico City; Acero Nacionales, S. A., a new company, started construction of a new plant that will include rolling mills and two or more electric furnaces at Tlalnepantla, 10 miles northwest of Mexico City; and another new company, Fierro Comercial, S. A., has started construction of a small plant at Ciudad Juárez to make steel bars, angles, structural beams, and similar products.

Lead and Zinc.—Production of lead and zinc in Mexico failed to respond to the upward climb of prices throughout the second half of the year and the final removal of price controls in the United States on November 10. Delayed response is expected in 1947 when, barring shut-downs by labor disputes, the mines, mills, and smelters should be operating at full capacity. Of the 140,143 tons of lead produced in 1946, 137,742 tons represented refined and semirefined forms and 2,401 tons metal contained in ores and concentrates; of the 139,535 tons of zinc, 41,982 tons were refined slabs and 97,553 tons contained in ores and concentrates. Exports of lead to countries other than the United States increased during the year, with substantial quantities going to various European countries and limited quantities to Argentina, Brazil, and Uruguay.

An outstanding event of the year was the discovery of important lead-zinc-silver ore bodies in the adjacent Concha and San Antonio mines in the Taxco district, Guerrero, at a time when the Minas de Guerrero mine in the same district was approaching exhaustion. The American Smelting & Refining Co., owner of the San Antonio mine, later (1947) arranged with the owners of the Concha to operate the two properties as a unit and expects to erect a mill. This will considerably extend the life of the district. Cía. Minera de Guerrero, S. A. (Eagle-Picher Co.), expects to terminate operation of its Taxco mine in 1947 and transfer its flotation mill to the newly reopened Esmeralda silver-lead-zinc mine of Eagle-Picher de Mexico, S. A., in the Parral district of Chihuahua. Eagle-Picher de Mexico also plans to reopen the Corralitos lead-gold mine in Chihuahua, about 100 miles southwest of El Paso, Tex. The Fresnillo Co. optioned the Santa Marta mine in western Chihuahua and El Gashi mine, Sonora, and has started exploration work.

Manganese.—Of the scores of manganese deposits worked during the war, only those of the Lucifer and Gavilán mines in Baja California, the Talamantes district in Chihuahua, La Abundancia mines in Zacatecas, and Montaña de Manganeso mine in San Luis Potosí were operated in 1946. Demand for the metal has been reduced, and the decline in production has been drastic. The Lucifer mine of Metales Mexico continued to be the most important single producer. Its sintering plant was closed in 1946, and the company now sends unsintered ores to the United States. An airplane landing strip was built to serve the Gavilán mine of Cía. Mexicana de Manganeso (Homestake Mining Co.), but the company suffered a set-back in September when its mill and various buildings in the mine area were destroyed by a cyclone.

Mercury.—From the war peak of 32,443 flasks in 1942, mercury production in Mexico declined moderately for 2 years and quite abruptly in 1945–46. Output in 1946 represented only 36 percent of that in 1942. Sources have not been reported in 1946, but it is believed that the Huahuaxtla district of Guerrero was the principal supplier, with remaining production divided among the Sain Alto district in Zacatecas and scattered areas in Durango, San Luis Potosí, Guanajuato, and Jalisco. The general drop in demand and consequently in price and the reentry of Italy into the world market contributed largely to the production slump.

Molybdenum.—The 75-percent increase in the 1946 production of molybdenum concentrates reflects what was probably a comparable increase in Cananea Consolidated Copper Co.'s output of copper concentrates, of which molybdenite is a byproduct. For many years the copper ores of Cananea, Sonora, have yielded virtually all of the molybdenite produced in Mexico.

Tin.—Illegal local sales of tin have long been common practice in Mexico, and it has been variously estimated that officially reported production represents somewhere between 30 and 85 percent of actual production, probably toward the higher percentages. It is evident that a few more of the small producers in five States (Durango, Guanajuato, Jalisco, San Luis Potosí, and Zacatecas) turned out more metal in 1946 than in 1945, but production remains relatively unimportant.

Tungsten.—The tungsten mines were reported closed for the first 8 months of 1946, but operations started in October so actively that production for the latter half was up 190 percent over that of the latter half of 1945, although totals for the 2 complete years showed a 26-percent decrease. The areas that registered this activity have not been identified. Most of the ore was scheelite.

Vanadium.—No vanadium ores have been mined or processed in Mexico since 1941. Inadvertent production includes the small quantities contained in Mexican crude petroleum, an unknown portion of which is recovered in the United States from soot collected from the boilers and stacks of ships that burn Mexican fuel oil.

NONMETALLIC MINERALS

Fluorspar.—It has been learned that annual production of fluorspar (not officially reported) customarily exceeds exports by about 2,150 metric tons, with the following break-down of consumption:

	Metric tons
Cía. Fundidora de Fierro y Acero de Monterrey	1,000
La Consolidada	600
Altos Hornos de Mexico	500
Total for steel making	2,100
Industrial de San Bartolo, S. A. de C. V., for hydrofluoric acid	50
Total known use	2,150

Fluorspar deposits have been reported in 13 States, but the most important exploitation developments have been made in the northern district, comprising adjacent sections of Chihuahua and Durango, and the southern district, in the States of Mexico and Guerrero.

The abrupt drop in output in 1946 showed the effect of the shut-down of the Azul mine near Taxco, Guerrero, which during the war supplied about half of Mexico's total production.

Graphite.—Exports of amorphous graphite are believed to represent total Mexican production, which is limited to that of two companies, Sonora Graphite Co., S. A., and Cía. Minera de San José, S. A., operating in the Guaymas district, Sonora. Production was well-maintained in 1946 and doubtless would have equaled or exceeded that of 1945 but for the coal and steel strikes in the United States during the first quarter. A large volume of orders at improved prices was received by both companies during the last quarter, but the year closed with a temporary shortage of railway cars and an accumulation of stocks at the mines. Prospects for 1947 are very good.

Mica.—Large scale mica mining in Oaxaca—the only Mexican State that has produced—ceased in June 1945, but scattered areas continued a small and unrecorded production of larger sheets used principally in the local manufacture of electrical appliances, such as flatirons. Exports in 1946 represented mica believed to have been imported in bond from Canada and the United States for splitting and trimming in the shops of Leo Framery in Querétaro. The Cía. Mercantil de Oaxaca shop, which formerly did this kind of work, has been closed down.

Salt.—Although salt production unfortunately is not entered in officially published statistics, the industry is large and has recently been well-described in a published report [6] with an accompanying map showing 52 active salinas in 15 states.

Strontium.—The normal relaxation of demand for strontium following the close of the war depressed the 1946 output of celestite by Mexico's principal producer, the Providencia mine at Villa de La Paz, San Luis Potosí, though not yet to the extent that had been anticipated. There is no known use of the mineral within the Republic, and all exports were to the United States.

Sulfur.—Sulfur production figures, which have never been complete, were not reported for 1946. The most important producing center is the area of Cerritos, San Luis Potosí; the melted and semirefined product is now being delivered in carlots to the new sulfuric acid plant of Cía. Minera Asarco, S. A., at San Luis Potosí, the ultimate purpose of which is to utilize sulfur now wasted in the smelting of sulfide ores.

In the course of drilling for oil, sulfur deposits said to be similar to those in the great producing centers of Texas and Louisiana have been discovered in five principal salt domes lying within a 20-mile-radius of Jaltipan, Veracruz, on the Isthmus of Tehuantepec. Explorations continued throughout 1946, with plans for extensive development by the Frasch process still under consideration.

HYDROCARBONS

Coal.—The upward trend in coal production that started in 1945 gained some slight momentum in 1946 which, if uninterrupted, should bring 1947 output to or beyond the 1943 level of 1,025,326 metric

[6] Lozano Garciá, Raul, Estudio Tecnologico de la Industria de la Sal en Mexico: Universidad Nacional Autonoma de Mexico, Instituto de Geologia, Mexico D. F., 1946, 70 pp.

tons, but the shortage of supply is still extreme. The Sabinas field in Coahuila is the principal producer, and nearly 60 percent of the total output goes to the inadequate production of coke. A plan to open a large new mine in the Sabinas area is being considered.

Petroleum.[7]—Production of crude petroleum, which has been accelerating in an upward climb that started in 1943, reached its highest level since 1928 in 1946. This apparent reflection of a healthy condition of the industry, however, may be misleading, as production in the near future probably will be downward if new fields are not discovered. Petróleos Mexicanos, the Government oil monopoly, was afflicted by disorganization and repeated strikes and shut-downs during most of 1946, but the outlook has greatly improved with the drastic reorganization that immediately followed inauguration of the new national administration on December 1.[8] Under a new director, Pemex is undertaking an extensive program of exploration and plans to sink a large number of wildcat and development wells in 1947, partly by contract with experienced American drillers.

BRITISH HONDURAS

Production of limestone from Government-owned quarries—the only known mineral industry in British Honduras—has been estimated at 31,000 metric tons in 1946 (25,400 cubic yards, valued at $38,100), compared with 29,000 tons in 1945 and 43,800 tons in 1944.

COSTA RICA

Gold and Silver.—As measured by United States imports from Costa Rica, production of precious metal concentrates and bullion dropped 59 percent in gold content—from 3,054 troy ounces in 1945 to 1,251 ounces in 1946—and 56 percent in silver content—from 1,380 ounces in 1945 to 604 ounces in 1946. The decline has been continuous in gold since 1941, in silver since 1944. A small part of the production originated in the placer operations of the Osa Peninsula, opposite Golfito, where plans of one group to start dredging have not yet materialized.

Panaminas, Inc., found no economically exploitable ore in its examination of the Albangares mining properties, and it abandoned exploration in February 1946.

The New York & Honduras Rosario Mining Co. continued development of the Union de Aguacate mine and operation of a small cyanide plant throughout 1946. Most of the year's total production is believed to have originated from this source. Two of the company's options expire in early 1947 and one in November; renewal will depend on results of development and legal negotiations.

Nonmetallic Minerals.—Pacific coastal salinas in the Provinces of Puntarenas and Guanacaste yielded 8,000 metric tons of salt in 1946, compared to 6,033 tons in 1945. Substantial but unknown quantities of limestone were quarried for use in building and calcined for use as whitewash, mortar, and fertilizer. A discussion of building-stone potentialities was published during the year.[9] Kieselguhr

[7] For further details see The Oil Weekly, 1947 World Oil Atlas, June 30, 1947, pp. 85–97.
[8] World Petroleum, Mexican Oil Situation Helped by Settlement of Labor Issue: Vol. 18, No. 8, August 1947, pp. 58–60.
[9] Bureau of Mines, Mineral Trade Notes: Vol. 23, No. 4, October 1946, pp. 18–19.

(diatomite) is found in a number of rich deposits and is extracted in small quantities by various operators for sale to sugar refineries and to manufacturers of electrical equipment. Production has been estimated at 50 tons in 1945, 5 tons in 1946. Sulfur deposits on the slopes of the Poas volcano are worked sporadically by rudimentary methods, but production is not on a commercial scale.

Petroleum.—No active petroleum exploration or exploitation was undertaken in Costa Rica in 1946, but several international firms approached the Government in regard to concessions. The interest shown has resulted in Congressional consideration of a basic petroleum law, the text of which was prepared by a commission of three engineers and presented to the Congress by the Ministerio de Fomento on September 1. Conclusive action by the Congress had not been taken by the close of the year.

EL SALVADOR

Gold and Silver.—Gold production as measured by exports, which decreased rapidly from 50,425 ounces in 1940 to only 16,526 ounces in 1945, reversed the trend and recovered to 21,798 ounces in 1946. Output of silver, also as measured by exports, rose from 223,705 ounces in 1945 to 313,180 ounces in 1946. The ratio of gold to silver has been erratic over the years, however, and the fluctuations in metal output do not necessarily reflect comparable variations in tonnages of ore mined.

All the gold and silver shipped in 1946 was the product of four operating mines: El Hormiguero mine of Comacaran Gold Mining Co.; Montecristo mine of Minas Montecristo, S. A.; Potosi mine of Cía. Minera de Oriente, S. A.; and San Sebastian mine of Butters Salvador Mines, Ltd. Ores of the Butters Salvador company contain small but unreported quantities of copper. This company is said to be in liquidation but has announced plans for extensive exploration work in 1947. Mineral Los Encuentros closed its properties sometime since 1944.

The New York and El Salvador Mining Co., Inc., a new subsidiary of the New York & Honduras Rosario Mining Co., engaged in favorable development of El Dorado mine near San Isidro. Construction of a mill with a capacity for 150 tons of gold-silver ore daily was started; and production is anticipated by the end of 1947, contingent upon delivery of equipment that has been ordered.

Lead and Zinc.—René Keilhauer, a French citizen, engaged in exploration and development of lead-zinc ores at the San Juan mine near the town of Metapan.

Other Minerals.—A number of small potteries, using native clays, produced an estimated 150 tons of clay products in 1946. No information has been received relative to other industrial mineral or mining activities during the year. Lime was being produced at the rate of 4,875 tons in 1944. Quarrying of ornamental stone has not been reported since 1941, nor have figures on salt production been received since 1944, when 1,894 tons were recovered from sea water.

GUATEMALA

METALS

Chromite.—Mine production of chromite in the Department of Jalapa is believed to have been approximately 600 tons of ore containing 300 tons of chrome oxide in 1946, compared to 442 tons of ore containing 211 tons of chrome oxide in 1945. All of the ore was stocked, and exports amounted to little or nothing during the year.

Gold.—Activity of individuals in panning alluvial gold dwindled toward the vanishing point during the past 5 years. The United States imported only 66 ounces of gold from Guatemala in 1945 and 36 ounces in 1946. During the last 3 years of dredging operations, gold production declined from 5,058 ounces in 1939 to 2,560 ounces in 1941.

Iron.—Iron ore for use in the Guatemala City cement plant is mined from a deposit near Zacapa at a rate of approximately 150 tons a month.

Lead and Zinc.—Lead smelting in small local furnaces from ore extracted in the vicinity of Huehuetenango usually yields 100 to 150 tons of lead metal a year, for domestic use only. Output was reported to be 115 tons in 1945 and 131 tons in 1946. Some interest was shown in lead and zinc mining in 1946; one well-known American firm established a local office, carried out prospecting operations, and requested development concessions, although actual production was not initiated.

NONMETALLIC MINERALS

Mica.—Mica mining in the Departments of Quiché and Baja Verapaz, while too small to be significant, appears to have overcome its 1944 slump of 468 kilograms and to be heading in the direction of its 1943 war peak of 5,356 kilograms. As measured by United States imports from Guatemala, production amounted to 1,156 kilograms (2,549 pounds) in 1945 and 3,689 kilograms (8,133 pounds) in 1946.

Salt.—The two methods of producing salt in Guatemala are solar evaporation of sea water and the boiling of coastal marine earths. Quantitative output has not been reported since 1944, when about 12,600 tons of salt annually was meeting the total needs of the country. The industry is regulated by an Inspector General of Salt Mines, under the Department of Agriculture.

Other Nonmetallic Minerals.—About 10 tons of crude sulfur are produced annually from numerous volcanic craters, and a small mineral pigments mill operating near San Juan Sacatépequez grinds unreported quantities of ocher, gray and blue-green earth, and "lignite powder"—probably a black oxide of iron.

HYDROCARBONS

Petroleum.—The draft of a new petroleum law, to replace the inadequate Ley de Hidrocarburos of 1933, was presented to the Congress in December 1946. Until this or a similar law is adopted, no action

is expected on several applications for concessions that were filed during the year, including one by a major United States oil company. Guatemalan areas showing favorable indications of potential petroleum production are in the Departments of Izabel, Alta Verapaz, and the Petán.

HONDURAS

Gold and Silver.—Of the 12,833 ounces of gold produced in Honduras in 1946, 12,095 ounces in doré bullion was derived from 202,225 tons of ore taken from the San Juancito mine by the New York & Honduras Rosario Mining Co., and 739 ounces in gold bullion was the product of individually mined placers. The total was 25 percent less than the 17,078 ounces recovered in 1945.

The same mine of the Rosario company dropped 11 percent in its output of silver in doré bullion. The 2,682,910 ounces in 1946 and 3,003,495 ounces in 1945 represented the total production of Honduras.

Exports in 1946 included a sample shipment of gold concentrates from the Agua Fria Mining Co., which started development operations after 3 years of inactivity and expects to resume production in 1947.

The Rosario company actively developed its newly acquired gold-silver mines at Yuscaran, Department of El Paraiso, and expects to be so engaged throughout 1947. Similar activity at its El Mochito silver-lead property, Department of Santa Barbara, was retarded by the lack of essential electrical and other supplies, which will not be obtainable before October 1947. Lack of equipment has also impeded systematic exploration of El Transito gold property near the Bay of Fonseca, Department of El Valle, which the company holds jointly with the American Smelting & Refining Co. Panaminas, Inc. (a subsidiary of Ventures, Ltd.), engaged in development work on a gold deposit in the Department of Comayagua.

The Pan American Mining & Development Co., after considerable work, abandoned its placer mining at El Viajao, Department of Olancho, and at least one other new company's explorations proved unsuccessful.

Antimony.—Commercial production of antimony was suspended in Honduras in 1945 with the closing of El Quetzal mine, Department of Copan. The reported production of 10 metric tons of antimony in 1946 represents metal contained in a sample shipment of 15 tons of ore assayed at 64.95 percent antimony from a claim near La Union, Department of Olancho, which, because of isolated location and lack of capital, probably will not be developed, at least for some time.

Iron.—The American steel company interested in iron ore deposits in the Departments of Yoro, Atlántida, and Comayagua—and particularly those at Agalteca, Department of Francisco Morazan—continued exploration throughout 1946 but found that transportation costs within Honduras did not favor further development.

Salt.—Recovery of salt by the evaporation of sea water, for domestic use only, amounted to 3,400 tons in 1942, 2,500 tons in 1943, and 2,700 tons in 1944. No explanation has been offered for the appreciable drop to 900 tons in 1945 and 850 tons in 1946.

Petroleum.—Several new contracts for petroleum exploration—all in eastern Honduras—were granted during the year.

NICARAGUA

Gold and Silver.—Exports of precious metals to the United States amounted to 206,389 ounces of gold and 223,308 ounces of silver in 1946, compared with 207,427 ounces of gold and 234,379 ounces of silver in 1945, showing declines of 0.5 and 4.7 percent, respectively.

Output by mines in 1946, in troy ounces, was as follows:

Company	Mine	Location	Gold	Silver
La Luz Mines, Ltd	La Luz	Siuna, Zelaya	60,351	39,464
Neptune Gold Mining Co	Neptune	Bonanza, Zelaya	55,918	85,908
Empressa Minera de Nicaragua	El Limon	Larreynaga, Leon	28,839	2,957
Cía. Minera de La India	La India	Santa Rosita, Leon	31,818	44,662
Cía. Minera de Jabalí	Jabalí	Santo Domingo, Chontales.	18,804	54,929
Cía. Minas Matagalpa	La Reina	San Ramon, Matagalpa.	5,044	13,811
Esmeralda	Esmeralda	La Libertad, Chontales.	236	----------
San Juan Mines Co	San Juan	do	1,770	2,208
Cía. Minera San Gregorio	San Gregorio	Santo Domingo, Chontales.	23,266	12,679
Total production			226,046	256,618

Salt.—Salinas on the west coast have been recovering about 6,000 tons of salt annually from sea water for several years, but exact figures are not available. The supply is not equal to domestic demand and is supplemented by imports.

Petroleum.—The American International Petroleum & Refining Co. continued seismographic exploration initiated in 1945. Results have not been announced.

Other Minerals.—Production reported only as insignificant includes copper, lead, and zinc in gold-silver concentrates, gypsum, lime, and sulfur.

PANAMA

Manganese.—Interest in possible renewal of manganese production has been noted in the grant of a concession in the hills near Nombre de Diós on the Atlantic coast, Province of Colón, exploration of which may be undertaken in 1947. The total production of manganese by Panama to date is 21,651 metric tons mined during the last 3 years of World War I (1916–18).

Salt.—Salt has been the only mineral produced in Panama since 1943. The Banco Agro-Pecuario e Industrial controls the industry and establishes annual quotas, under which system output of various salinas amounted to approximately 10,000 metric tons in 1944, 2,437 tons in 1945, and 7,958 tons in 1946. Recovery from sea water is expected to be limited in 1947 to about half that of 1946, or 4,000 tons.

Hydrocarbons.—A contract was signed in September 1946 between the Panamanian Government and American oil interests for the exploration of potential petroleum deposits within the Republic.

SOUTH AMERICA

ARGENTINA

The new regime of President Juan D. Perón, although not inaugurated until June 1946, exercised a powerful influence on the affairs of the country throughout the year. A multiplicity of Government measures in 1946 shaped a new economic policy for Argentina leading toward the adoption of a Five-Year Plan (1947–51) involving substantial increase in Government control over the domestic economy. The plan embodies 27 bills gaged to vast economic and social development and setting goals for 1951 that include a 43-percent increase over 1943 in the value of goods processed, a 52-percent increase in wages, a 34-percent increase in employment, a 50-percent increase in motive power installed, improvement and expansion of railway facilities to connect major and projected industrial, mineral, and agricultural areas and new centers of population, and the improvement of river transportation and port facilities. The policy of the Government is to own and operate all essential public services that are national in their scope; ownership of the railroads and most of the gas services and internal telecommunication systems has already been obtained.

Government reorganization included the centralization of all statistical services under the newly created National Administration of Census, Research, and Statistics, which suspended the issuance of basic statistics relating to trade and industrial development, with the exception of the petroleum industry. Information covering operation of the minerals industries since 1942 is spotty and incomplete, and a comprehensive review of 1946 cannot be presented. Nothing is known of developments in arsenic, antimony, bismuth, chromite, columbite-tantalite, copper, gold and silver, vanadium, zinc, or any of the nonmetallic minerals. The June 1946 issue of Industria Minería (Argentine Chamber of Minerals) made the following observations on tungsten, mica, beryl, and lead:

> Export minerals, especially wolfram, mica and beryl are still governed by a series of factors which are not dependent upon demand, since requests for export permits for beryl and wolfram run into a number of difficulties in the offices dealing with those minerals, which paralyze all export possibilities. The latest requests presented for the export of wolfram have not been granted the benefits of preferential exchange, while beryl has no official privileges which permit its export, all of which obviously causes unrest and uncertainty in market operations.
>
> In reality there is interest as regards the export of wolfram and beryl and although the former has undergone a long period of quiet due possibly to the large reserves in the possession of purchaser countries, we hope that a new demand for this mineral will be forthcoming as these supplies are slowly used up. Beryl, on the other hand, can be placed at once but it is not possible to obtain official export facilities in spite of the continued efforts made by the Chamber to this end.
>
> According to the latest information, the time is not far distant when there will be official measures to bolster lead prices. This will increase the present market value of lead and thus, at prices which take into consideration mining costs, transport, etc., the exploitation of this mineral could be more rational and more intense.
>
> The government has recently made purchase agreements for lead with Peru and overtures are being made to do the same with Bolivia in spite of the fact that it is well known that there are large quantities in this country.

The most significant event in the metallurgical industry was approval of the Argentine Steel-Making Plan providing for expansion of present iron- and steel-making facilities (which produced about

120,000 metric tons in 1946) to an annual capacity of 315,000 tons, utilizing iron ore from Cerro de Zapla and Puesto Niejo in the Province of Jujuy. (Maximum iron-ore production last reported was 3,750 tons in 1941.) Initial capitalization of the new Argentine Mixed Steel Corp. is to be 90 percent by the Government and 10 percent by private shareholders, with private shareholders privileged to acquire up to 40 percent after the first year of operation.

Refined-lead production dropped 24 percent from 21,159 tons in 1945 to 16,190 tons in 1946—the lowest since 1940—of which 15,225 tons was derived from domestic and 965 tons from Bolivian concentrates. Other metallurgical operations resulted in the estimated 1946 production of 850 tons of tin and 1,814 tons of electrolytic zinc, both representing substantial increases over 1945 and the war years.

Production of solid mineral fuel, comprising approximately 98,600 tons of asphaltite and 9,000 tons of lignite in 1944, has not been reported since. The solid-fuel situation for Argentina was greatly improved in 1946, however, when 1,146,415 tons of coal and coke were made available through imports, compared with 798,875 tons in 1945.

Crude-petroleum production in 1946 was 20,603,729 barrels,[10] the lowest since 1939; a shortage of drilling and pumping equipment probably will not permit reversal of the downward trend before 1948. Since the end of the war, consumption—and consequently imports—have increased. The petroleum section of the Five-Year Plan proposes to produce enough petroleum in Argentina to provide for the needs of the country, as well as to maintain adequate reserves both above and below ground.[11] Provision is made for an extensive program of increasing refinery capacity and for the renewal of extracting equipment for the existing fields. It may be expected, however, that Argentina will have to depend rather heavily on imports for some years to come.

BOLIVIA

General.—The total value of reported mineral exports from Bolivia, exclusive of petroleum and petroleum products, declined 11 percent in 1946 to US$65,460,138, compared with US$73,861,581 in 1945. Production of mercury, asbestos, and fluorspar ceased before the beginning of 1946, and both value and quantity decreased during the year of all products except antimony, columbite, copper, cement, and petroleum refinery products. Columbite was produced for the first time in Bolivia in 1945.

The general decrease in production reflects the many labor difficulties that faced the mining industry in 1946; a series of serious strikes with many threats of violence not only hampered operations but caused many foreign technical personnel to leave the country. The revolution of July 21 and the days of mourning for ex-President Villarroel also contributed to production losses, while increased labor costs and the steadily declining metallic content of most ores forced complete closure or drastic curtailment of operations of many of the smaller and some of the larger mines. The 30- to 50-percent increases

[10] For additional details of production see The Oil Weekly, 1947 World Atlas, June 30, 1947, pp. 137–147.
[11] See also Rikles, Bernardo, Oil's Part in Argentina's Five-Year Plan: World Petrol., vol. 18, No. 8, August 1947, pp. 46–47.

Mineral production of Bolivia, 1945–46, in metric tons (unless otherwise indicated)[1]

Mineral		1945	1946	Change, percent
METALS IN CONCENTRATES (EXPORTS)				
Antimony		5,535	6,964	+26
Columbite concentrates (gross)	kilograms	[2] 469	3,116	[3]
Copper		6,097	6,127	+1
Lead		9,508	8,434	−11
Mercury	76-lb. flasks	3		−100
Silver	troy ounces	6,683,561	6,106,165	−9
Tin		43,169	38,322	−11
Tungsten		3,851	2,120	−45
Zinc		20,976	19,118	−9
NONMETALLIC MINERALS (PRODUCTION)				
Asbestos		61		−100
Cement		27,534	30,742	+12
Fluorspar		19		−100
Sulfur		617	471	−24
HYDROCARBONS (PRODUCTION)				
Petroleum, crude	42-gal. bbl.	381,554	362,599	−5
Petroleum refinery products	do	218,460	223,934	+3

[1] Exclusive of bismuth and gold, for which export figures are not believed to be indicative of production; and of clay, lime, salt, and stone, which are produced for domestic use in quantities not reported.
[2] United States imports from Bolivia.
[3] Over 500 percent.

in wages won by labor were partly offset by the increase in cost of living as measured by the official index, and continued labor troubles are anticipated throughout 1947.

METALS

Antimony.—A guaranteed price offered by Banco Minero throughout 1946 supported antimony mining, which was accelerated during the last quarter enough to push the total year's output ahead of the 1945 figure but short of the 7,448 tons exported in 1944.

Bismuth.—As pointed out in this chapter last year, exports of bismuth in concentrates ordinarily reflect production but are not believed to have done so since 1943, when the purchase agreement with the United States Commercial Company was terminated. Exports of bismuth in concentrates, amounting to 12,419 kilograms in 1943, virtually ceased for a time while concentrates separated as a byproduct of tin mining accumulated in the country. Exports, in kilograms of contained bismuth, actually amounted to 605 in 1944, 15,337 in 1945, and 27,867 in 1946. If this represents a cumulative production approximating 43,809 kilograms over the 3-year period, it seems reasonable to suppose that the distribution of production, paralleling that of tin, may have been somewhat of the order of 14,300 kilograms in 1944, 15,600 in 1945, and 13,900 in 1946.

Columbite.—It has now been learned that the Bolivian Development Corp. in 1945 actually did reopen the La Verde mine, near Santa Cruz—formerly worked for mica— and produced columbite amounting to 469 kilograms, as measured by United States general imports. With the initial work completed, output jumped to some importance in 1946, with 3,116 kilograms reported officially, and the outlook for the next few years appears favorable.

Copper.—The Corocoro mine of the American Smelting & Refining Co., the Pulacayo mine of Cía. Minera Huanchaca de Bolivia, the Animas mine of Cía. Aramayo de Minas en Bolivia, and various small properties combined to maintain copper production at the virtually constant level of the previous 6 years. The Corocoro mine contributed by far the largest portion of the total.

Lead and Zinc.—The anticipated continuation of the 1945 upward trend in lead and zinc was deflected downward in 1946 by labor troubles. Cía. Huanchaca de Bolivia contributed the major part of the production of both metals. Nothing more has been heard of plans, discussed in 1945, for construction of a lead smelter in southern Bolivia. Most of the lead concentrates, as in the past, were shipped to Argentina for smelting.

Precious Metals.—Gold exports in 1946 amounted to 2,853 ounces, compared with a figure for 1945 reported last year as 28,901 ounces, but since changed without explanation to 3,180 ounces. With unknown quantities retained within and possibly smuggled out of Bolivia, production cannot be estimated. Early in the year, in a new attempt to increase the purchase of gold by Banco Central and Banco Minero and to stop contraband sales to neighboring countries, the Government published a decree prohibiting the sale and transfer of gold between private persons and entities and imposing heavy penalties for violators. Efforts of two companies to gain new contracts for the exploitation of gold in the Tipuasi-Rio Kaka region, to replace contracts abrogated in 1944, were unsuccessful, but will probably be renewed in 1947.

Silver production followed the downward trend of the base-metal concentrates from which it is derived as a byproduct.

Tin.—Patiño's new sink-and-float plant for the Llallagua mine at Catavi attained successful operation, but Cía. Minera Unificada del Cerro de Potosi (Hochschild) announced its intention to abandon its Tainton-process plant as a failure.

Experimental runs were started in midyear at a new tin smelter owned by Mariano Peró, near Oruro. Eventual planned output is 200 tons of 98-percent tin per month, but the lack of coal is regarded as one serious obstacle to realization.

The contract signed with Bolivian independent producers in September 1945 established a price of \$0.60½ per pound of tin delivered in the first quarter of 1946 and \$0.58½ per pound in the second quarter, at the end of which the contract expired. A new contract covering the latter half of the year was signed August 14, 1946, setting a base price of \$0.62½ per pound and making that price effective retroactively to January 1, 1946. During the last quarter, conversations started between representatives of the Bolivian and Argentine Governments that later (1947) led to a contract for delivery of 8,000 tons of tin to Argentina in 1947 and established a 1947 price of \$0.76 per pound.

The outstanding operational development in Bolivian tin mining during 1946 was the spread of resistance of operators to high costs and what they consider unreasonable labor and social laws by closing down, discharging the workers, and then rehiring them on a purely contractual basis. Strong opposition to this system, which relieves

the companies of compliance with many social laws relating to hours, wages, housing, and medical attention, is expected from the Federation of Mine Workers in 1947, when an effort to outlaw the practice is anticipated. Included among the mines that have followed or initiated this procedure are the Huanuni mine of the Bolivian Tin & Tungsten Corp. and the Oploca mine of Cía. Minera y Agricola Oploca de Bolivia (Patiño group), and the San José mine of Cía. Minera de Oruro (Hochschild group), all large producers. The interruption of operation of these mines, of Patiño's Catavia mine, and of the Santa Fé mine contributed to the over-all decline in 1946 tin production. Several other mines that threatened to close were kept open by Government grants of compromise concessions relating to specified tax exemptions and special foreign exchange privileges.

Tungsten.—The downward trend in tungsten-ore production that started in July 1944 continued through 1946 with total exports lower than in any year since 1937. The Caracoles-Tazna mine of Cía. Aramayo de Minas en Bolivia was the most important source of ore. The Banco Minero attempted to stimulate production by purchasing all wolframite offered to it and waiving export taxes.

NONMETALLIC MINERALS

Production of fluorspar was initiated and suspended between the beginning and close of 1945. Asbestos exports, never important in Bolivia, ceased during 1946 but may be expected to be resumed in 1947 to fill commitments to Argentina, provided the Argentine-Bolivian agreement on economic, financial, and cultural cooperation, signed March 26, 1947, is ratified. Ratification of this agreement should also reverse the 3-year downward trend in the production of sulfur, which in 1946 reached its lowest point in at least 14 years.

HYDROCARBONS

Petroleum.—Although Yaciementos Petrólifera Fiscales Bolivina, the State petroleum monopoly, made very slight progress in the development of the Camiri and Sanandita oil fields in 1946, it was more than offset by the reduced output of the Bermejo field.

All of the crude produced at Bermejo and a large part of the fuel oil from the Sanandita refinery were sold to Argentina. Most of the remaining refinery products were sold locally, while the needs of the larger consuming centers of the Andean highlands, such as La Paz, Cochabamba, and Oruro, were largely supplied by imports from Peru.[12]

BRAZIL

Reports of 1946 mineral production in Brazil are spotty. As in past years, production is accepted as being fairly well indicated by exports of those items for which there is relatively little or no market within the country. Statistics for 1945 having been unavailable at the time of last year's review, the accompanying table presents a comparison of 1944 and 1945, with such preliminary 1946 figures as have been reported.

[12] See The Oil Weekly, 1947 World Oil Atlas, June 30, 1947, pp. 151–153.

Mineral production of Brazil 1944–46, in metric tons (unless otherwise indicated)

Mineral	1944	1945		1946	
		Quantity	Change, percent	Quantity	Change, percent
METALLIC ORES AND METALS					
Aluminum metal	----------	[1] 275	-------	[1] 250	−9
Arsenic oxide (white arsenic)	840	962	+15	[1] 900	−6
Beryllium concentrates (exports)	1,185	510	−57	1,294	−154
Chromite	[1] 4,721	[1] 1,490	−68	[1] 3,600	+142
Columbite (exports)	----------	----------	-------	7	-------
Gold, troy ounces	[1] 178,300	[1] 212,200	+19	[1] 200,000	−6
Iron ore	769,497	[1] 716,000	−7	[1] 1,000,000	+40
Iron and steel:					
Pig iron	292,169	259,909	+11	[1] 365,000	+40
Rolled iron	166,534	165,805	(2)	(3)	(4)
Steel ingots, bars, and rods	221,188	205,935	−7	(3)	(4)
Manganese ore, 38–50 percent Mn	237,898	196,000	−18	(3)	(4)
Silver, troy ounces	28,722	28,385	−1	[1] 26,700	−6
Tantalite (exports)	254	30	−88	44	+47
Titanium concentrates (exports):					
Ilmenite	3,250	5,000	+54	[1] 4,000	−20
Rutile	1,564	160	−90	28	−83
Tungsten ore, 60 percent WO_3 equivalent (exports)	2,221	2,192	−1	1,623	−26
Zirconium concentrates (exports)	2,152	758	−65	4,453	+487
Ores, type not specified (exports)	309	372	+20	6,475	(5)
NONMETALLIC MINERALS					
Agate, ornamental (exports)	16	(3)	(4)	41	(4)
Amblygonite	600	(3)	(4)	(3)	(4)
Barite	282	617	+119	(3)	(4)
Cement	809,908	774,378	−4	824,900	+7
Diamonds:					
Gem stones, carats	262,505	(3)	(4)	(3)	(4)
Carbonados, do	38,372	(3)	(4)	(3)	(4)
Total diamonds, do	300,877	[1] 275,000	−9	[1] 325,000	+18
Lime	442,081	(3)	(4)	(3)	(4)
Marble	16,821	(3)	(4)	(3)	(4)
Mica (exports)	941	984	+5	1,148	+17
Monazite sand (exports)	3	1,030	(5)	1,250	+21
Phosphate rock (apatite)	5,216	(3)	(4)	(3)	(4)
Quartz crystal (exports)	1,122	609	−46	161	−74
Salt	546,635	430,408	−21	(3)	(4)
Stones, semiprecious (exports):					
Agate, gem, grams	19,226	20,918	+9	----------	−100
Aquamarine, do	72,857	107,144	+47	93,693	−13
Amethyst, do	131,075	149,283	+14	318,478	+113
Cat's eye, do	(6)	121	(4)	302	+150
Citrine, do	137,565	131,923	−4	183,312	+39
Garnet, do	32,177	80,354	+150	53,023	−34
Topaz, do	22,072	135,464	+514	18,880	−86
Tourmaline, do	9,592	19,950	+108	10,543	−47
Other, kind not specified, do	59,037	750,210	(5)	1,069,627	+43
Total exported, do	483,601	1,395,367	+188	1,747,858	+25
HYDROCARBONS					
Coal, net weight	1,433,158	1,500,702	+5	1,225,248	−18
Petroleum, crude, 42-gallon barrels	57,534	79,265	+38	66,697	−16
Petroleum refinery products, do	(3)	267,732	(4)	376,600	+41

[1] Approximate production.
[2] Less than 0.5 percent.
[3] Not reported.
[4] Figure not available.
[5] More than 500 percent.
[6] Included in "other, kind not specified."

The year 1946 was one of transition in the sense that the mining industry as a whole returned largely to established commercial trade channels in replacement of the government purchasing programs of the war period, and European markets again became a trade factor.

Brazilian producers, however, were still handicapped by Government control of export prices and permits, which complicated and retarded trade.

Outstanding development of 1946 was the promulgation of the new Brazilian Constitution [13] and the provision which permits the entry of foreign capital into the country, as a Brazilian corporation, to participate in all types of mining activities. This liberalization is a reversal of the nationalistic 1937 constitution, which denied such rights to anyone other than native-born Brazilians. Exercise of like privileges to foreign capital in exploration for petroleum must await adoption of a new petroleum law, the drafting of which was unfinished by mid-1947.

METALS

Aluminum.—The Ouro Preto plant of Eletro-Quimica Brazileira closed down without remotely approaching its announced anticipated capacity of 2,500 tons of aluminum ingots a year. The company is said to have been unable to reduce its costs to a level at which it could compete with imported metal.

Beryl, Tantalite, and Columbite.—Mining of these three minerals, which generally occur together, was resumed in 1946 following more than a year's shut-down that had resulted from Government regulation of exports. Shipments of beryl were good but not up to the earlier war years. Tantalite shipments were up relative to 1945, but not proportionately to those of beryl. Prices were not conducive to larger sales. Columbite was exported for the first time since 1942.

Chromite.—At midyear Chromita do Brazil S. A. was producing about 300 tons of chromite ore a month from its mine in Bahia. This rate was more than twice that of 1945.

Chromium Mineração, S. A., discontinued shipment of ore from its Piuhy (Minas Gerais) property. Freight rates, plus the difficulty and expense of raising its substantial reserve of 35-percent ore to 45-percent Cr grade by sorting, has made continued operation unprofitable. Ore samples have been sent to the United States for experimentation on a suitable process for concentration.

Gold, Silver, and Arsenic.—The St. John del Rey Mining Co. is still the leading gold-mining company in Brazil, but since enactment of the law of June 19, 1945, revoking the obligation to sell all gold to the Banco do Brazil, total Brazilian production is difficult to obtain. Break-down of 1945 output shows 147,270 ounces from St. John del Rey, 12,386 ounces from Cia. Minas de Passagem, 2,139 ounces from Cia. Brazileira de Mineração, S. A., 1,311 ounces from Minas Leão Jr., Limitada, and an estimated 49,094 ounces (23 percent of the total) from some 50,000 individuals engaged in placer panning. In 1946, still unreported quantitatively, the industry suffered somewhat from increased costs against controlled sales value. Placer production represented an estimated 20 percent of the total. It seems reasonable to expect that production at about the 1946 rate will continue for some years to come.

[13] An English translation of the old Brazilian Mining Code of 1940 and Amendments is available free on request to the Bureau of Mines, Foreign Minerals Branch, Washington 25, D. C. At the close of 1946 a new code was being drafted to conform with the new constitution.

As byproducts of gold-arsenopyrite ores in Minas Gerais, silver and arsenic are presumed to have been produced in slightly less quantities than in 1945.

Iron and Steel.—Iron-ore production has been estimated for the year 1946 at 1,000,000 tons, indicating a substantial increase over the estimated 716,000 tons mined in 1945 and suggesting an abundance of stocks accumulated at the new Volta Redunda plant of Cia. Siderúrgica National (National Steel) and at charcoal furnaces. The signing of an agreement on April 26, 1946, between the Hanna Exploration Co. and the government of the Territory of Amapá marked the first attempt of a foreign company to undertake mining in Brazil under the terms of the new constitution of the Dutra government. Preliminary drilling indicated that the hematite ore bodies may not be as extensive as originally hoped.

A new 50-ton-per-day charcoal-iron blast furnace near Corumba, Mato Grosso, was added to the 25 previously in operation, to supply the São Paulo market. Belgo-Mineira Co. continued in heavy activity, and Cia. Ferro Aço of Victoria started expansion of its facilities; the total output of pig iron rose 40 percent.

Construction of the Volta Redonda iron and steel plant of Cía. Siderúrgica Nacional is nearly complete. On February 20 the coke ovens were lighted; on June 9 the first blast furnace was blown in, pouring pig iron 2 days later; on June 25 the first steel was produced; and on October 12 the plant opened its rail-rolling and shapes unit and began operating at a rate of approximately 500 tons a day, or about half of the designed capacity. The most serious operational problem is the procurement of coal in quantities and quality adequate for the new plant, as coal production in southern Brazil has not reached expectations. Volta Redonda has depended almost entirely on coal imports from the United States and probably will continue to do so for some time.

Considerable progress was reported toward completion of a specialized steel plant of Cía. de Aços Especiais Itabira near Coronel Fabriciana, Minas Gerais, which is expected to supplement the production of Volta Redonda by specializing in the output of complex alloy steels.

Lead.—New equipment was installed late in 1946 at the Ribeira plant of Cía. Plumbum, S. A., the only producer of refined lead during the year, in the hope of increasing output by a large margin. Production amounting to only 25 tons in 1945 may have reached 1,500 tons during 1946.

Manganese.—Manganese production in 1946 has not been reported quantitatively but is said to have declined in respect to 1945 principally because of increased freight rates and poor transportation facilities. New management acquired control of the Minas da Bahia and announced that it was equipping the mine for immediate production. The Hanna Exploration Co. started examination of a new and important discovery of several million tons of manganese ore, reportedly of shipping grade, on the Amaperi River, Territory of Amapá.

Tin.—Minas de Estanho de São João d'El-Rei has proposed construction of a gravity-concentration plant with a capacity of 100–125 tons a day of ore containing cassiterite. This represents the first

known attempt to mine lode tin ore in Minas Gerais, although alluvial deposits have yielded cassiterite from which more than 300 metric tons of metallic tin a year have been refined.

Titanium.—No reports have been received on the production of titanium ore in 1946. No ilmenite was exported, but some was doubtless separated from beach sands and stocked for future sale. Representatives of several American organizations made a survey during 1946 of beach sands of Esperito Santo, with a view toward development of an improved process for the recovery of ilmenite with monazite and zircon as byproducts.

The 28 tons of rutile shipped may have been from stocks mined in 1945, and probably were washed from alluvial deposits of central Goiaz.

Tungsten.—Diminished 1946 production of tungsten ore, as measured by exports, reflects the postwar reduction in price. Output of scheelite from northeastern Brazil and wolframite from the Irhandjara mine in São Paulo is expected to continue at about the 1946 level of roughly 1,600 tons of 60-percent WO_3 (equivalent) concentrate, unless altered by a price change or stimulated by foreign aid in mining and milling.

Zirconium.—A single large shipment to Norway boosted 1946 exports of zirconium concentrates to the highest tonnage since 1943. Production is from São Paulo, Minas Gerais, and is a byproduct from the monazite-ilmenite beach sands of Espirito Santo.

NONMETALLIC MINERALS

Barite.—Cía. Pigmentos Minerais Industrial e Comercial, S. A., completed installation of mining, milling, and dock facilities on Camamú Island, Bahia, and initiated operation of its barite grinding and bagging mill on January 22, 1946. First shipment was made in April, and sales to the Caribbean oil fields' market were well-sustained throughout the remainder of the year. Total output reached probably 20,000 tons.

Diamonds.—Diamond production has been estimated at 325,000 carats in 1946 and 275,000 carats in 1945. Exports in 1946, compared parenthetically with 1945, amounted to 113,815 (39,355) carats of rough gem stones, 12,645 (49,010) carats of cut gems, and 9,070 (3,960) carats of carbonados, giving totals of 135,530 (92,325) carats of diamonds. Exports bear no constant relation to production. The estimated 1946 production increase is in part based on discovery in the State of Piauhy, in April, of new alluvial deposits, which were worked intensively for several months but largely abandoned before the end of the year.

The number of people employed by diamond cutters in Brazil declined from a peak of about 3,000 to only 1,500 in 1946, reportedly because of the shortage of rough stones for cutting, and some of the cutters returned to Europe.

Graphite.—Graphite is mined by Cía. National de Grafite, Ltda., near Itapecerica, Minas Gerais. The indicated production in 1944 was about 800 tons of concentrates. Graphite exports—not indicative of production—amounted to 199 tons in 1944, 131 tons in 1945, and 92 tons in 1946.

Marble.—About 17,000 tons of marble are produced annually from

8 States, principally Minas Gerais, Rio de Janeiro, Santa Catarina, and São Paulo.

Mica.—The total 1946 increase in mica exports was not in line with the downward trend toward the end of the year. Production in 1947 may be expected to find a level lower than 1946 but possibly somewhat higher than that of prewar years. No new prospecting or development was done; and, in general, mica mining has reverted to its traditional unorganized methods.

Monazite.—Monazite was favored by good demand in 1946, and exports of sand from the beaches of Espirito Santo were up 21 percent in respect to 1945.

Phosphate.—Although present production of phosphate is not known, output from the Ipanema and Jacupirana (São Paulo) apatite deposits by Serrana S. A. de Mineração was reported to be increasing slightly from the 5,216-ton level of 1944. Production is far below fertilizer requirements but can hardly be improved substantially without the introduction of more efficient and larger-scale methods of ore treatment.

Quartz Crystal.—The continued postwar slump in demand for quartz crystal resulted in 1946 exports amounting to less than a fourth of 1945 shipments. Export volume in 1947 is not expected to exceed 10 or 12 tons a month.

Semiprecious Stones.—Compared with 1945, exports of semiprecious stones were up in quantity but down in value. While the European market again became a trade factor, purchase interest in the United States became dull, except for rare stones of good quality, and Brazilian production exceeded demand.

HYDROCARBONS

Coal.—Production of cleaned coal available for market in 1946 has been estimated at 676,000 tons from Rio Grande do Sul, 474,248 tons from Santa Catarina, 70,000 tons from Parana, and 5,000 tons from São Paulo. The 1,225,248-ton total was 18 percent less than that for 1945; an appreciable increase from Santa Catarina was more than offset by the decrease from Rio Grande do Sul resulting from operational difficulties and protracted labor disputes. In an attempt to improve production generally, the Government by decree placed distribution of all Brazilian coal in the hands of the Ministry of Transport and Public Works and fixed values for the different types of coal mined. United States control authorities sharply curtailed the export of deep-mine coal in the late part of 1946, and Brazilian importers registered complaints over the decrease in quality of coal received.

Petroleum.[14]—Brazil's decrease in crude-oil production from 79,265 barrels in 1945 to 66,697 barrels in 1946 was the result of deliberate limitation forced by an inadequacy of refining facilities and pipe-line outlets. The accompanying table summarizes the Brazilian petroleum situation for the past 2 years.

These figures clearly demonstrate how far short Brazil is of meeting current domestic requirements with domestic resources and facilities. Refinery production is from five small plants. Plans are under way by Conselho Nacional de Petroleo for immediate construction of a

[14] For a more detailed review see The Oil Weekly, 1947 World Oil Atlas, June 30, 1947, pp. 155–57.

Salient statistics of petroleum industry in Brazil, 1945–46, in barrels of 42 gallons

	1945	1946
Production, crude:		
Candeias field	36,663	52,145
Aratu field	6,717	4,554
Itaparica field	29,154	9,768
Lobato-Joanes field	6,729	
Pitanga field		230
Total crude production	79,263	66,697
Imports, crude	259,150	133,776
Total crude newly available	338,413	200,473
Production, refinery products	267,732	376,600
Imports, refinery products	10,087,123	16,376,768
Total refinery products newly available	10,354,855	16,753,368
Refinery products marketed in Brazil	10,896,833	15,725,672

refinery of 2,500-barrel daily capacity in the vicinity of the oil fields in Bahia, and consideration is being given to the proposed construction of four larger plants in São Paulo and Rio de Janeiro to add a combined daily capacity of 32,000 barrels.

BRITISH GUIANA

Bauxite.—Exports of bauxite recovered from a 2-year slump and reached 1,137,991 metric tons in 1946 compared with 750,398 tons in 1945—an increase of 52 percent. (Production was 678,482 tons in 1945; production in 1946 was virtually the same as exports.) Most of the shipments were destined for Canada, but the United States took some 70,000 tons, and smaller consignments (less than 10,000 tons each) went to the United Kingdom, Sweden, and Argentina. The upward break in output came during the second quarter of the year, when additional Canadian ships became available for service on the Canada-British Guiana route. Demerara Bauxite Co., Ltd. (Aluminum Co. of Canada), and Berbice Co., Ltd. (American Cyanamid & Chemical Corp.), were the only active producers in the colony. Undeveloped deposits of bauxite were examined during the year by engineers representing the Reynolds Metals Co. and the Kaiser interests.

Gold.—The upward trend in crude gold production that started with 22,533 troy ounces in 1945 (18,986 ounces in 1944) continued to 24,741 ounces in 1946. (Fineness was reported for the first time in 1946 at 0.800, indicating a fine-gold production of 19,793 ounces. Whether the same degree of fineness is applicable to preceding years has not been established.) The increase was less than anticipated in view of new discoveries by the two established companies—Cuyuni Goldfields, Ltd., and British Guiana Consolidated Goldfields, Ltd.—and the advent of at least two new companies, Rupununi Gold Mining Co. and Wairiri Gold Mines, to the fields, and more substantial advances are expected in 1947. Concessions are said to have been granted recently to American and Swedish interests, and greater exploitation of lode deposits has already started.

Diamonds.—Diamond production jumped to 30,958 carats, of which 28,745 carats were exported in 1946, doubling the recovery of 15,442 carats in 1945, when 17,251 carats were exported. The

excellent world market for diamonds stimulated activity in general, and the Consolidated African Selection Trust, Ltd. (a West African concern controlled by De Beers), negotiated for permission to operate on a large scale within an area of 4,260 square miles in portions of the drainage basins of the Ireng, Burro Burro, and Siparuni Rivers. If the plans of this company are successfully completed they may be expected to contribute effectively to the badly needed organization of the industry.

Granite.—Production of quarried stone, chiefly granite, rose 74 percent from 25,688 tons in 1945 to 44,805 tons in 1946. Total output was for construction use within the colony.

CHILE

Production in 1945, not available in last year's review, is presented in comparison with 1944 in the accompanying table, together with such preliminary 1946 production figures as have been reported.

Mineral production in Chile, 1944–46, in metric tons (unless otherwise indicated)

Mineral	1944	1945		1946	
		Quantity	Change, percent	Quantity	Change, percent
METALLIC ORES AND METALS					
Cobalt, in ore	5	1	−80		−100
Copper, in ore	498,520	446,398	−11	365,034	−18
Copper, refined	489,906	440,289	−10	358,963	−18
Gold, troy ounces	243,883	180,462	−26	185,903	+3
Iron ore	674,529	944,863	+40	1,352,886	+43
Iron, pig	18,413	172,242	[1]	[2]	[3]
Lead, refined		26		86	+231
Manganese ore, 40–50 percent Mn	43,989	7,445	−83	22,157	+298
Mercury, 76-pound flasks	997	862	−14	827	−4
Molybdenum, in concentrates	1,051	841	−20	560	−33
Silver, troy ounces	1,094,894	1,070,219	−2	823,220	−23
NONMETALLIC MINERALS					
Asbestos		313		280	−11
Barite	1,630	3,097	+90	3,752	+21
Borates	2,323	1,188	−49	1,477	+24
Cement	362,877	411,088	+13	579,906	+41
Clay:					
Kaolin	366	3,602	[1]	6,464	+79
Other	[2]	339	[3]	570	+68
Dolomite		21		25	+19
Feldspar	[2]	124	[3]	44	−65
Gypsum, calcined	32,225	39,302	+22	[2]	[3]
Iodine, crude	1,329	697	−48	620	−11
Iron oxide	180	300	+67	[2]	[3]
Kieselguhr (diatomite)	784	233	−70	70	−70
Lime	476,768	[2]	[3]	[2]	[3]
Limestone:					
For lime	[2]	[2]	[3]	81,976	[3]
For cement	601,912	639,550	+6	803,576	+26
Agricultural	10,203	[2]	[3]	35,153	[3]
Other	[2]	[3]	[3]	4,085	[3]
Nitrates	973,615	1,366,877	+40	1,617,717	+18
Phosphate rock (apatite)	14,376	13,203	−8	15,210	+15
Quartz	2,852	60,002	[1]	46,022	−23
Salt, common	45,691	47,760	+5	59,405	+24
Sodium carbonate ("soda ash")	70	[2]	[3]	[2]	[3]
Sodium sulfate	13,232	13,497	+2	13,198	−2
Sulfur:					
Contained in crude caliche (sales)	5,155	8,314	+61	9,213	+11
Granular and sublimate	25,707	20,757	−19	6,216	−70
Talc	19	477	[1]	640	+34
HYDROCARBONS					
Coal, net weight	2,046,919	1,827,182	−11	1,740,213	−5

[1] More than 500 percent. [2] Not reported. [3] Figure not available.

METALS

Copper.—The sharp 1946 decrease in copper production can be attributed to three causes. Strikes closed El Teniente plant of the Braden Copper Co. during October and November and the Chuquicamata plant of the Chile Exploration Co. during June; a serious water shortage further reduced output at El Teniente throughout December; and the customs smelters at Chagres and Naltagua were closed during the entire year coincident with virtual elimination of small mine production following cancellation of the U. S. Commercial Company contract in the latter part of 1945. A number of small mine operators announced their intention to reopen to take advantage of the increased price of copper, and it is rumored that the Chagres smelter may also reopen.

Gold.—Of the 1946 gold production, 32,514 ounces were in precious metal ores and concentrates, 6,600 ounces in base metal ores and concentrates, 21,922 ounces in copper bars, 120,031 ounces in gold bars from lode mines, and 4,836 ounces in gold bars from placers.

Iron and Steel.—The substantial increase in 1946 iron-ore production reflected a comparable increase in availability of ships for ore exporting, which still regulates production. Cía. de Acero del Pacifico has acquired property on San Vincente Bay near Concepción, and construction of a 180,000-ton steel plant, started in 1946, is expected to be completed in 1949. The plant will be under American management and its planned capacity is adequate to provide Chile with its basic iron and steel requirements.

Manganese.—Increased production of manganese ore over that of 1945 still fell far short of previous years. The Coquimbana mine of Manganeso de Atacama, S. A., was the only one in operation during 1946. The Government decreed that all sales and deliveries of metallurgical-grade manganese ore shall be controlled by Government regulation. The decree does not apply to manganese dioxide, production of which amounted to 4,880 tons in 1946.

Mercury.—The Punitaqui mine, Province of Coquimbo, continued throughout 1946 as Chile's only producer of mercury. Output receded to 827 flasks, the lowest since 1940.

Molybdenum.—Separation of molybdenum concentrates from El Teniente copper ores of the Braden Copper Co. was well below the 1945 output, because of forced curtailment of operations during the last quarter of the year.

Silver.—Silver production as reported for 1946 was the smallest since 1933. Of the total, 491,971 ounces, or 60 percent, was in copper bars; 128,313 ounces in ores, concentrates, and precipitates; and 202,936 ounces in refined bars.

NONMETALLIC MINERALS

Nitrates.—Chile's postwar recovery of nitrate production continued following a temporary set-back resulting from a prolonged strike by the Tocopilla dock workers. Only 12 oficinas were in operation at

the end of 1946, compared with 19 on June 30 and 22 on January 1, but the major oficinas entered 1947 working at full capacity.

Production in 1946 of such minerals associated with nitrate as sodium and calcium sulfates, potassium chloride, and sodium carbonate has not been reported. Output of iodine and sodium sulfate dropped slightly, while that of borates increased.

HYDROCARBONS

Coal.—Decreased coal production in 1946 was a result of the closing of 7 of the 30 operating mines in Chile and of serious labor conflicts experienced by the 2 large producers in the Concepción area. The output trend was up during the last quarter, however, and throughout the year the balance between production and consumption remained about equal.

Petroleum.[15]—Progress of the Corporacion de Fomento de la Produccion in its effort to expand the Springhill field was slight; 4 holes were completed in 1946, of which 2 showed some promise. Springhill Nos. 1 and 3 are shut in pending construction of handling facilities; a dock and storage tanks are now being erected at Bahia Gente Grande that are to be linked with Springhill by a pipe line. The Fomento Corporation has announced plans to construct a 10,000-barrel refinery near Viña del Mar to process both imported and national crude.

COLOMBIA

Mineral production of Colombia, 1945–46, in metric tons (unless otherwise indicated)

Mineral	1945	1946	Change, percent
METALS			
Precious metals:			
Gold, troy ounces	506,695	437,176	−14
Silver, do	168,699	152,651	−10
Platinum, do	34,757	44,539	+28
Lead, refined	20	[1]	[2]
NONMETALLIC MINERALS			
Barite (estimated)	2,600	2,600	
Cement	302,730	[3] 328,000	+8
Gypsum (estimated)	17,200	18,300	+6
Salt:			
Terrestrial	90,627	92,460	+2
Marine	14,445	31,907	+121
Total salt	105,072	124,367	+18
HYDROCARBONS			
Petroleum, crude (incl. natural gasoline), bbl. (42 gal.)	22,903,732	22,518,174	−2
Petroleum refinery products, do	[4] 4,854,000	5,241,720	+8

[1] Not reported.
[2] Figure not available.
[3] Estimate based on actual production of 300,720 tons during the first 11 months.
[4] Approximate.

[15] See The Oil Weekly, 1947 World Oil Atlas, June 30, 1947, pp. 157–159.

METALS

Precious Metals.—The decline in gold and silver production has been gradual but continuous since 1941, reflecting the effect of wartime difficulties in obtaining new machinery and equipment, and of continuously rising costs against static gold prices and relatively ineffectual changes in the price of silver. The two metals occur together and are mined from lodes and placers. A detailed review of the industry was made available.[16]

Platinum production from streams on the Pacific slope showed marked improvement, and was the highest since 1941. The largest production is from dredges of the South American Gold & Platinum Co. along the San Juan River.

Iron and Steel.—The proposed Paz del Rio iron and steel project sponsored by the Instituto de Fomento Industrial is still in the planning stage, and no date has been announced for the start of plant construction. At present one small furnace at Pacho is making about 5 tons of pig iron per day.

Lead.—The small pilot plant at Mochancata appears to have been inactive in 1946, as no lead production was reported.

NONMETALLIC MINERALS

Barite.—Barite production, unreported quantitatively, is estimated to have continued at approximately the 2,600-ton annual rate of the past 2 years. Quarries in the Departments of Santander and Tolima sell chiefly to oil companies for use in drilling, and in minor quantities to local manufacturers of paint and other commodities.

Salt.—The salt industry showed healthy activity in 1946, particularly in the recovery of salt from sea water. Since 1943, terrestrial figures have not shown the breakdown between rock salt and salt contained in brines, which up to that time had been produced in a ratio of roughly 1:15.

HYDROCARBONS

Coal.—Coal-production figures have not been made available for the past 2 years. The upward trend, starting with 403,345 tons in 1941 and reaching 499,169 tons in 1944, suggests a figure somewhere close to 550,000 tons for 1946. Colombian coal is of excellent grade; it is largely consumed within the Republic.

Petroleum.[17]—Although both petroleum production and the productive potential increased steadily from 1942 (following a sharp recession) through 1945, output in 1946 was forced into a reduction by labor difficulties late in the year. Drilling activity, however, was greater than in any year since 1939.

[16] Cathart, James K., Résumé of Gold Mining in Colombia: Bureau of Mines, Mineral Trade Notes, Special Supp. 11, December 1946, 19 pp.

[17] See The Oil Weekly, 1947 World Oil Atlas, June 30, 1947, pp. 165–173.

ECUADOR

Mineral production of Ecuador, 1945–46, in metric tons (unless otherwise indicated)

Mineral	1945	1946	Change, percent
METALLIC ORES AND METALS			
Copper:			
In concentrates [1]	4	40	[2]
In blister bars [1]	3,285	2,659	−19
Total copper [1]	3,289	2,699	−18
Lead, in concentrates [1]	183	308	+68
Gold (estimate) troy ounces	66,975	77,931	+16
Silver (estimate) do	235,500	192,200	−18
NONMETALLIC MINERALS			
Cement	37,504	38,497	+3
China clay	40	46	+15
Geyserite	65	21	−68
Iron oxide	4	17	+325
Ocher	6	[3]	[4]
Salt, marine	27,600	35,090	+27
Sulfur, crude	103	26	−75
HYDROCARBONS			
Asphalt, natural	3	[3]	[4]
Coal	41	[3]	[4]
Gasoline, natural barrels (42 gallons)	41,768	40,690	−3
Petroleum, crude do	2,663,726	2,322,569	−13
Petroleum refinery products do	912,402	1,065,024	+17

[1] United States general imports from Ecuador, regarded as more nearly indicative of actual production than Ecuadorian official figures.
[2] Over 500 percent.
[3] Not reported.
[4] Figure not available.

METALS

Gold and Silver.—Except for minor placer operations, the mining of gold, silver, copper, and lead in Ecuador has been confined to two American companies with interlocking directorates. The Cotopaxi Exploration Co., following failure to find a new ore body, ceased operating its silver-gold-copper-lead mine at Macuchi in July 1946. The South American Development Co. recovered from the low year that followed the break-down of one of two hydroelectric plants and the flooding of its gold-silver-lead mine at Portovelo, in El Oro Province, near the close of 1944. However, the company continued to operate under difficulties and has sought tax relief from the Government to forestall the possible necessity of closing down. The Government was studying these proposals when 1946 ended.

The increases in the production of gold and lead obviously are not significant, and the only bright spot in the future outlook for gold lies in possible large-scale development in the region of the Toachi River in Cotopaxi Province, just south of the Quito-Esmeraldas highway. Intensive explorations in this region, begun in March 1946, are said to have resulted in showings of considerable promise.

Copper and Lead.—Recovery of copper in the form of blister bars at the Macuchi smelter ceased following closing of the mine, ending what has been virtually the total output of the country. Closing of the Macuchi mine also means that the 1947 and subsequent produc-

tion of lead will be confined to the lead content of gold-silver concentrates issuing from Portovelo, until new lead-bearing deposits may be discovered and developed.

NONMETALLIC MINERALS

Salt.—Most of the 1946 salt production came from the privately owned salinas of Santa Elena, the small remainder from the Government-owned salinas of Punta Arenas. Total output showed a substantial increase over that of 1945, to about the level of 1944.

Minor Industrial Minerals.—Activity of the Government-owned sulfur mine at Tixan, Province of Chimborazo, was almost dormant in 1946. As usual, minor production was maintained in china clay, geyserite, and iron oxide. No information has been received on the output of ocher, gypsum, and stone.

HYDROCARBONS

Petroleum.[18]—Commercial production of crude petroleum continued to be confined to the peninsula of Santa Elena in 1946. The International Ecuadorian Petroleum Co. abandoned its efforts to find oil elsewhere and withdrew from the country in the early part of 1947, while the Shell Co. of Ecuador, Ltd., continued its exploration of the Oriente region. Nearly half of the crude petroleum produced in Ecuador is refined for use within the country.

FRENCH GUIANA

The time may be ripe for some interest to be shown in expanding gold production and examining some of the bauxite, and possibly iron, deposits known to exist within the colony.

Gold.—Placer gold production, which declined from 37,606 ounces in 1939 to 20,609 ounces in 1943, appears to have become fairly well stabilized slightly below the low figure. Official figures show 18,583 ounces in 1944, 20,631 ounces in 1945, and 19,749 ounces in 1946. Most of the production comes from the Territory of Inini, which supplied 18,701 ounces of the total in 1945 and 17,774 in 1946.

PARAGUAY

Paraguay has no established mining or mineral industry of commercial interest, although there is a small production of limestone and lime, building stone, and salt.

Petroleum.—The Union Oil Co., which since January 1945 has had two seismographic crews exploring in the Gran Chaco, started drilling its first test well on July 16, 1946. Exploration probably will continue for several years.

PERU

The production trend in 1946 for Peruvian mineral products generally was downward, with the exception of bismuth, coal, and a few minor items. The decline in production, and consequently in

[18] See The Oil Weekly, 1947 World Oil Atlas, June 30, 1947, pp. 177–181.

Mineral production and exports of Peru, 1945–46, in metric tons (unless otherwise indicated)

Mineral	Production			Exports		
	1945	1946	Change, percent	1945	1946	Change, percent
METALLIC ORES AND METALS						
Antimony	2,301	1,205	−48	2,184	1,096	−50
Arsenic oxide (white arsenic)	2,717	726	−73	4,003	2,891	−28
Bismuth kilograms	308,946	311,549	+1	318,888	321,697	+1
Cadmium, in refined bars do	9,320	1,388	−85	1,019	2,462	+142
Copper	31,916	24,700	−23	28,568	26,119	−9
Gold troy ounces	172,661	158,378	−8	129,760	140,480	+8
Indium grams	41,459	155,692	+276	41,457	155,692	+276
Lead	53,664	44,518	−17	52,609	44,018	−16
Mercury 76-pound flasks	209	5	−98	208	5	−98
Molybdenum	29	4	−86	29	3	−90
Silver troy ounces	12,997,741	12,334,761	−5	[1]10,568,841	[2]10,211,750	−3
Tin, in dross	55	31	−44	1	2	+100
Tungsten concentrates, 60 percent WO_3 equivalent	523	510	−2	332	748	+125
Vanadium	688	324	−53	688	333	−52
Zinc	61,154	53,410	−13	47,099	59,242	+26
NONMETALLIC MINERALS						
Aluminum sulfate	328	99	−70	328	99	−70
Barite	4,240	[3]	[4]			
Cement	264,892	260,617	−2		[3]	
Clay	50,325	[5] 50,000			300	
Feldspar	27	330	[6]	[3]	[3]	[4]
Graphite, flake	[3]	[3]	[4]	[3]	10	[4]
Gypsum:						
Crude	37,998	49,582	+30			
Calcined	26,979	26,035	−3	2	[3]	[4]
Lime	14,660	15,450	+5	[3]	[3]	[4]
Limestone	474,711	471,083	−1			
Magnesium sulfate	705	428	−39	706	434	−39
Manganese sulfate	26	12	−54	26	44	+69
Marble, architectural	3,677	[3]	[4]	379	1,174	+210
Mica:						
Trimmed	30	20	−33	20	14	−30
Scrap	460	187	−59	175	156	−11
Total mica	490	207	−58	195	170	−13
Mineral water gallons	2,075,642	2,195,948	+6			
Onyx, ornamental	267	[3]	[4]		212	
Salt	55,143	56,613	+3		[3]	
Sand, gravel, and crushed stone	194,928	[3]	[4]			
Silica, glass-grade	8,039	[3]	[4]			
Sulfur	1,216	369	−70	550	375	−32
HYDROCARBONS						
Coal:						
Anthracite	36,848	82,089	+123	27,381	60,245	+120
Bituminous	164,415	147,561	−10			
Total coal	201,263	229,650	+14	27,381	60,245	+120
Natural gasoline 42-gallon barrels	1,075,137	1,041,536	−3	[3]	[3]	[4]
Petroleum, crude do	13,744,216	12,455,991	−9	272,488	1,648,066	[6]
Petroleum refinery products do	13,369,339	11,393,757	−15	8,941,179	6,595,754	−26

[1] Exclusive of 466,186 ounces of silver art objects.
[2] Exclusive of 273,281 ounces of silver art objects.
[3] Not reported.
[4] Figure not available.
[5] Approximate.
[6] Over 500 percent.

exports, has been attributed principally to labor shortages at the mines and a normal decline in the productivity of existing oil fields. Comparison of production and exports during the past 2 years is presented in the accompanying table. It will be noted that 1945

production figures are official data replacing the preliminary estimates presented in last year's review; the new data reveal that actually the 1944–45 production trend was upward instead of downward (as first reported) for antimony, cadmium, lead, zinc, magnesium sulfate, mica, and mineral water, and downward instead of upward for gold and silver.

METALS

Antimony.—Production in 1946 was only slightly more than half that of 1945 but exceeded 1944 by about 20 percent. Of the 1946 total, 808 tons was in various ores and concentrates and the remainder in products of the Cerro de Pasco Copper Corp. smelter at Oroya: 227 tons in crude antimony bars, 1 ton in refined bars, 168 tons in antimonial lead bars, and 1 ton in lead-tin-antimony bars.

Byproduct Metals.—White arsenic, bismuth, cadmium, indium, tellurium, tin, and sulfuric acid are all byproducts of smelting operations of the Cerro de Pasco plant at Oroya. The 1946 output of crude white arsenic and refined cadmium followed the decrease in the treatment of copper, lead, and zinc ores. Bismuth production was upheld by a well-maintained rate of ore output at the principal bismuth-producing mine, San Gregorio, belonging to the Fernandini interests. The relatively great increase in refining of indium resulted from expanded operation of the recovery plant rather than an increased supply of metal in ore. Tellurium recovery, initiated with 140 kilograms in 1943, has not been reported quantitatively since that year. Recovery of tin in the process of lead smelting is maintained at an annual level well below 100 tons.

Copper.—Continued decrease in copper production in 1946 was due to a shortage of mine labor and to continued decrease in the grade of ore from the principal copper districts, which have been marked by a declining output trend since 1929. Of the 24,700 metric tons mined in 1946, 19,400 tons were extracted at the Oroya plant of Cerro de Pasco Copper Corp. in the form of blister bars, 206 tons in matte, and 303 tons in electrolytic bars. The copper refinery under construction at Oroya probably will not be completed before 1948 or early 1949.

Gold.—Compared with 1945, the 1946 production of gold was down in total in all categories except content of gold-silver bars, which amounted to 79,040 ounces in 1945 and 91,150 ounces in 1946. Production associated with complex ores, compared paranthetically with 1945, amounted to 12,316 (16,438) ounces contained in ores, concentrates, precipitates, etc., and 42,811 (54,157) ounces contained in copper bars. Placer production dropped from 23,026 ounces in 1945 to only 12,101 ounces in 1946. The Peruvian Government has been studying ways whereby capital may be attracted to gold mining on a larger scale. Particular attention is being given to the possibilities of establishing dredging operations, and some competent organization might find the present time favorable for negotiating with the Government for exploration rights with a view to obtaining operational concessions.

Iron and Steel.—During 1946 the Peruvian Government agency "Corporación Peruana del Santa" continued to investigate and plan for establishing a steel industry at Chimbote. The plan includes

electric furnaces to utilize power from the hydroelectric plant now under construction at Cañon del Pato for the smelting of iron ore from the Marcona deposits about 200 miles south of Lima, where transportation facilities are being constructed.

Lead.—Lead production dropped to approximately the level of 1942, due partly to a cave-in that temporarily disrupted operations at the important mine of Cía. des Minas de Huaron and partly to the lessened output at some of the smaller mines resulting from decline in the grade of ore mined. Of the total 44,518 metric tons of lead in ore mined in 1946, 38,058 tons were recovered at the Oroya plant of the Cerro de Pasco Copper Corp. in refined lead bars and impure bars.

Mercury.—Suspension of operation of practically all of the few small mercury mines of the country reduced production and exports of mercury to almost nothing in 1946. The low price of mercury brought about this situation and was also responsible for stoppage of construction of the hydroelectric plant that was to have supplied power for the new concentrating plant at Huancavelica, erected in 1945 to treat cinnabar ore from the Santa Barbara mine.

Molybdenum.—With liquidation in 1945 of Peru Molibdeno, S. A., production in 1946 was confined to the negligible output of the Salazar mine.

Silver.—Distribution of 1946 production of silver, compared parenthetically with 1945, shows 3,850,598 (3,350,847) ounces in untreated base-metal ores and concentrates, 27,232 (27,360) ounces in gold-silver bars from the gold lode mines, and—from the Oroya plant of the Cerro de Pasco Copper Corp.—687,318 (1,231,406) ounces in 0.999 fine refined bars, 1,850,211 (1,928,530) ounces in 0.925 fine sterling bars, 5,918,791 (6,459,598) ounces in copper bars, and 611 (none) ounces in lead-tin-antimony bullion. The decrease followed the decline in base-metal production, of which virtually all of the silver is a by-product. Exports of silver art objects suggest that the activity of Peruvian silversmiths may have subsided somewhat since 1945.

Tungsten.—Rising prices upheld production of tungsten concentrates during most of the year, particularly from the principal mines of Malaga Santolalla i Hijos in north-central Peru, where mining was unfortunately interrupted in November by a severe earthquake that badly damaged surface installations. Production was expected to be back to normal by May 1947, and construction started on a new concentrating mill of 150-ton-per-day capacity by August.

Vanadium.—The new $4,000,000 plant at Junasha—completed in 1945 with Defense Plant Corporation funds and designed to treat low-grade ores from the Minaragra mine—was purchased by the Vanadium Corp. of America in 1946. The abrupt decrease in 1946 production was due to exhaustion of the known higher-grade portions of the ore body, which necessitated the shut-down of the old mill, and difficulties encountered in attaining satisfactory extraction of vanadium from the lower-grade "Broza" ore by lixiviation in the new plant, which is now reported to be working more efficiently.

Zinc.—Increased zinc output of the large Volcan mine in 1946 was insufficient to offset larger decreases from the Huaron, Cercapuquio, and San Antonio Esquilache mines. All zinc concentrates are exported, except for enough to feed Cerro de Pasco Copper Corps'. pilot plant at Oroya, which produced for export 1,583 metric tons of

refined electrolytic bars in 1945 and 1,331 tons in 1946, plus 105 tons in 1945 and 142 tons in 1946, for sale to domestic users. The company plans to erect an electrolytic refinery and is stock-piling zinc concentrates at Cerro de Pasco for such future treatment.

NONMETALLIC MINERALS

Marble.—Exports of Peruvian marble have increased in the past 2 years to meet an apparently growing market in eastern United States.

Mica.—Production of mica was completely shut down about the end of 1945 when a satisfactory postwar market could not be found. Statistics for 1946 appear to indicate the resumption of operations, although reported production and exports may represent shipments from previously accumulated stocks.

Other Nonmetallic Minerals.—Peru continues to export small quantities of aluminum, magnesium, and manganese sulfates, graphite, onyx, and sulfur, having little importance individually but notable value in the aggregate.

HYDROCARBONS

Coal.—Continued expansion in development of the anthracite field at Ancos far outweighed the 10-percent drop in bituminous-coal output, netting a 14-percent gain in total coal production and supplying all of the coal sold in export. Anthracite represented only 3 percent of total coal production in 1942, 36 percent in 1946. Continued growth will follow realization of the industrial development of the Chimbote area.

Petroleum.[19]—Crude petroleum production in 1946 dropped 9 percent from that of the preceding year, continuing the decline that began in 1944. An effort to open new areas of crude production was seen in preparations for wildcat drilling on the Ucayali River, Cantamana region, about 125 miles north of Aqua Caliente, by Establicimientos Petroliferos Fiscales (Peruvian Government) and Cía. Petrolera de Oriente, a private Peruvian company. The former agency is also attempting, by wildcatting, to reopen the Pirin area, northwest of Lake Titicaca, Puno Province, which has been unproductive since 1940. Independent experts, who have projected the natural decline of production from present fields and the growing domestic consumption of petroleum products, predict that unless new oil fields are discovered and developed Peru will cease to be a petroleum-exporting country by the end of 1953.

SURINAM

Bauxite.—Shipments of bauxite have been increasing steadily since 1944 and in 1946 surpassed those of the best prewar years, with 827,843 tons, compared with 683,961 tons in 1945. The Paranam and Moengo mines of the Surinam Bauxite Co. supplied 94 percent (775,386 tons) of the total. The Billiton Co. (N. V. Billiton Maatschappij), on a contract of about 100,000 tons, shipped 52,457 tons from its stock pile to American interests, delivered to Baton Rouge, La.

New calcining equipment installed at the Paranam plant of the Surinam Bauxite Co. early in 1947 and the acquisition of new ships by Alcoa are expected to speed the output of bauxite in 1947.

[19] See The Oil Weekly, 1947 World Oil Atlas, June 30, 1947, pp. 185–191.

During the year both the Permanente Metals Corp. (a subsidiary of the Kaiser Corp., Oakland, Calif.) and the Reynolds Metal Co. sent engineers to Surinam to prospect for bauxite. Permanente obtained an option on a large area not far from the town of Albina on the Marowijn River and is engaged in detailed examination. The Reynolds Co. applied to the Government for a concession covering another discovery, but no action had been taken by the close of the year.

Gold.—Production of gold dropped 21 percent from 5,895 ounces in 1945 to 4,648 ounces in 1946. Of the 1946 output, 2,314 ounces came from Sara Creek Gold Fields, 885 ounces from Whitewater Mines, Ltd., and 1,449 ounces from individual placer mines. Production is handicapped by difficult problems of transportation, high cost of food and supplies, and the low price, equivalent to $30.05 an ounce, paid by the Surinam Bank, where by law all gold must be sold. Nevertheless, interest seems to be growing in the development of new placers on the Lawa River and of lode-mining possibilities elsewhere. Several groups, including foreign companies, have sent engineers to examine a mining district near the Government railroad south of Paramaribo, and construction of a small mill has been started at the old Savannah mine with the intention of working a deposit of gold-bearing quartz. Some results of these activities should become apparent in 1947.

URUGUAY

There has been no ore production in Uruguay since 1941, when gold was last produced on a commercial scale. Nonmetallic minerals, chiefly for use in construction, find a ready market domestically and

Mineral production of Uruguay, 1945–46, in metric tons (unless otherwise indicated)

Nonmetallic minerals	1945	1946	Change, percent
Agate, rough (exports)[1]	19	40	+111
Abrasives, aluminous (exports)	1,635	623	−62
Cement	185,290	[1] 220,000	+19
Clay: Common	578,408	[1] 600,000	+4
Refractory	1,592	2,298	+44
Feldspar	265	513	+94
Gravel	252,121	407,241	+62
Mica, ground		6	
Quartz, ground	1,357	2,015	+48
Sand [2]	2,333,918	2,007,558	−14
Semiprecious stones [4] (exports)—kilograms	[3]	[5]	[5]
Shale	2,683	[3]	[5]
Stone, industrial:			
Ballast	[1] 110,000	278,286	+153
Flagstone—square meters	500	302	−40
Granite: Rough	[1] 62,000	83,817	+35
Cut	[1] 1,400	22,620	[6]
Curbstones—linear meters	[1] 7,000	5,092	−27
Paving blocks—units	[3]	30,240	[5]
Limestone	390,432	449,063	+15
Marble	33,360	1,833	−95
Marl	[5]	500	[5]
Talc, crude	1,823	1,818	[7]

[1] Estimate.
[2] Includes granite sand: 1945—quantity not reported; 1946—31,150 tons.
[3] Not reported.
[4] Cut agate, amethyst, aquamarine, topaz.
[5] Data not avilable.
[6] Over 500 percent.
[7] Less than 0.5 percent.

to a considerable extent in foreign trade, particularly with Argentina, Paraguay, and Brazil. The accompanying table summarizes a preliminary comparison of production in the past 2 years.

The general upward production trend in most mineral items reflected the continuance of a construction boom and was accompanied by a predominantly downward trend in exports. In general, the prices of construction materials showed exorbitant increases, in many instances doubling those of 1940. Relief from the paralysis of imports of gypsum from Argentina came in the third quarter with the arrival of 2,520 metric tons from France.

VENEZUELA

Mineral production of Venezuela, 1945–46, in metric tons (unless otherwise indicated)

Mineral	1945	1946	Change, percent
METAL			
Gold, troy ounces	58,397	36,904	−37
NONMETALLIC MINERALS			
Asbestos	(1)	65	(2)
Cement	124,447	128,329	+3
Diamonds, carats	12,769	20,912	+64
Salt, marine	44,166	90,555	+105
Magnesite, crude	5,600	2,750	−51
HYDROCARBONS			
Coal	7,022	3,621	−48
Petroleum, crude—bbl. (42 gal.)	323,156,264	388,486,224	+20
Petroleum refinery products	32,549,423	34,998,158	+8

[1] Not reported.
[2] Figure not available.

METALS

Gold.—Venezuela's steady decline in gold production since the peak year 1940 has been due largely to the wartime difficulties encountered by mining companies in obtaining essential transportation and replacement equipment, complicated by continued unrest among the miners. During 1946 the weakened financial position of New Goldfields of Venezuela, Ltd., the largest producer, was bolstered by a loan from the Venezuelan Government. This new capital, however, proved inadequate for continued operations, and on November 15 the properties were turned over for development work to Guayana Mines, Ltd., a company newly organized by Ventures, Ltd., of Toronto, Canada, and its subsidiary, Panaminas, to exercise an option granted the previous month. This interruption of production will undoubtedly result in a further decline in 1947, as the properties of New Goldfields normally supply about 78 percent of the country's total output of gold. Most of the remaining portion comes from Vuela Caras mine, also in the State of Bolivar, while placer deposits in the Caroni region continue to yield minor values.

Iron.—Additional progress was made by the Iron Mines Co. of Venezuela (Bethlehem Steel Co.) in its program for the development of ore deposits at El Pao, but considerable work must yet be completed before actual production can be started. A deep-water loading station, originally planned for a small island off the coast of Trinidad,

has been relocated to the southern coast of the Paria Peninsula, near the municipality of Cristóbal Colón. The second of a fleet of four ore ships was launched in March 1947.

The Oliver Mining Co. (United States Steel Corp.) explored concessions obtained from the Government late in 1945, and discovered iron deposits reported to be of commercial size and grade in the vicinity of Tucupita, in the Orinoco delta. Development on a commercial scale may be undertaken.

Nickel.—Sampling of the garnierite deposit at Lorno de Hierro near San Pedras, State of Aragua, was completed by the International Nickel Co. Development of the property will probably depend on current metallurgical research.

Vanadium.—During 1946 the United States imported 44 metric tons of flue dust containing 17 tons of V_2O_5, or 9 tons of vanadium, from Curaçao, compared with 61 tons of flue dust containing 21 tons of V_2O_5, or 12 tons of vanadium, in 1945. This represents material derived from crude petroleum of Venezuelan origin, though only a portion of the total potentially available from that source.

NONMETALLIC MINERALS

Asbestos.—Cía. Anónima Minas de Amiante de Tinaquillo, which started operation of its asbestos mill west of Tinaquillo, State of Cojedes, late in 1945, continued at a restricted operating rate throughout 1946. Preliminary figures suggest that either the grade of ore, which yielded 64,997 kilograms of fiber, or the efficiency of recovery was disappointingly low and that the extraction of asbestos in Venezuela must still be regarded as experimental.

Diamonds.—Venezuela responded to a record world diamond market with a 64-percent increase in production over 1945 but failed to equal that of any of the years 1941–44. Production by districts (all in the State of Bolivar) was as follows, in carats:

Producing district	*1945*	*1946*
Lower Caroni-Paragua Basin	2, 414. 28	5, 114. 36
Upper Caroni Basin (Gran Sabana)	10, 228. 00	15, 577. 64
Cuyuni and Mazaruni (Kamarán) Basins	126. 60	219. 63
Total Venezuela	12, 768. 88	20, 911. 63

Of possible significance was the first authoritative identification, in 1946, of carbonado from Venezuela. This form of diamond has never been produced on an important scale outside of Brazil.

Magnesite.—The future of Venezuela's magnesite industry depends on the growth of domestic demand for calcined products. After 23 years of inactivity, production was resumed on Margarita Island in 1943 by La Industria Nueva Esparta, C. A. Deposits range in grade from 20 to 92 percent magnesite; only the high-grade is being worked. The company ships crude to its plant at Palomar for calcining, and thence to its factory at Caracas.

Salt.—Recovery of salt from sea water, principally on the Araya Peninsula, State of Sucre, in 1946 was the highest on record.

Other Nonmetallic Minerals.—Quantitative production of limestone, lime, gypsum, clay, sand, and gravel has not been reported.

HYDROCARBONS

Coal.—Privately owned mines in the Coro district, State of Falcon, supplied 2,690 of the 3,621 tons of coal mined in 1946. The remaining 931 tons came from the Government-owned Naricual mine in the State of Anzoátegui.

Petroleum.[20]—In 1946 Venezuela further strengthened its position as the world's second largest petroleum producer by establishing a new all-time record output for the third successive year. The Western district, including the great Lake Maracaibo Basin, produced 266,765,995 barrels of crude; the Eastern district, including the States of Monagas and Anzoátegui and the Territory of Delta Amacuro (and 91,692 barrels from the new Central district in the State of Guarico), 121,720,229 barrels. The Creole Petroleum Corp. (Standard Oil Co. of New Jersey), the Shell Oil Co., and the Mene Grande Oil Co. (Gulf Oil Corp.) produced 95 percent of the total; the remaining 5 percent was the product of nine companies. Of 627 holes drilled during the year, 574 resulted in new producing wells.

Eight refineries treated 32,645,515 and 35,160,905 barrels of crude oil in 1945 and 1946, yielding 32,549,423 and 34,998,158 barrels of refinery products, respectively. At the end of the year, three complete refineries were still in the planning stage, one was under construction by Shell, and two small skimming plants, also by Shell, were nearing completion.

[20] See The Oil Weekly, 1947 World Oil Atlas, June 30, 1947, pp. 195-209.

INDEX

By MABEL E. WINSLOW

A

Page

Abrasives, artificial, production 92, 93
review 107
foreign trade 92, 93, 109
metallic, shipments 93, 107
sources 108
stocks 108
uses 109
natural, production 92, 93
technology 93
Abrasives industries, annual review 92
salient statistics 93
Acid phosphates, exports 1003
Africa. *See* Belgian Congo; Cyprus; Egypt; French Morocco; Madagascar; Nigeria; Rhodesia, Northern; Rhodesia, Southern; South-West Africa; Spanish Morocco; Swaziland; Union of South Africa.
Agate, deposits, discovery 546
Air conditioning, gas-operated equipment 834
Air furnaces, consumption of ferrous scrap and pig iron 655
Alabama, bauxite, production 175, 176
bituminous-coal industry, data 272, 273, 285, 290, 295, 296, 297, 300, 305, 306, 307, 313, 314, 317, 318, 319, 320, 323, 324, 326.
gold, production 1416, 1418
iron-ore industry, review 600, 603, 604, 605, 606, 607, 608, 609, 614, 617, 618, 621
minerals, production 28, 30
value 20, 30
petroleum industry, review 880, 882, 883, 885, 905, 909, 911, 913, 915, 918, 941, 950
Alabaster, producers, list 596
mining methods 596
uses 596
Alaska, asbestos, sources 144
bituminous-coal industry, data 272, 273, 290, 293, 295, 296, 297, 300, 305, 306, 314, 320, 323, 324, 326
coal, low-grade, as source of fuel briquets 536
production 1309
Cook Inlet-Susitna region, metals, production 1303
copper, production 1299, 1302
Copper River region, metals, production 1303, 1304
gold, producers, list 1301
production 1299, 1300, 1301, 1302, 1303
gold bullion, deposited at U. S. Assay Office 1303
gravel, production 1309
Kenai region, metals, production 1303, 1304
Kuskokwim region, metals, production 1303, 1304
lead, production 1299, 1302, 1303
lignite, production 1309
mercury, data 769, 770, 771, 1309
minerals, production 28, 31, 1299
value 20, 31
mineral industry, bibliography 1310
mining industry, review 1299
nephrite, data 545, 1309
Northwestern region, metals, production 1305
sand, production 1309
Seward Peninsula region, metals, production 1303, 1305
silver, production 1299, 1302, 1303
silver bullion, deposited at U. S. Assay Office 1303
Southeastern region, metals, production 1303, 1306
tungsten, production 1309
tungsten, data 1194, 1195
Yukon River region, metals, production 1303, 1306

Page

Alcoa, rulings against, under Surplus Property Act 114
Alloys, high-temperature, wartime uses 392
Alloy steels, production 634
Alumina, production 180
Alumina abrasives, natural, review 104
Alumina plants, rated annual capacity 114
Aluminum, foreign trade 111, 117, 119
prices 111, 112, 118, 119
primary, consumption 111, 116, 117
price control 118
production 111, 112, 115, 117, 122
salient statistics 111
secondary, annual review 1068
price 1068
recovery 111, 116, 117, 1065, 1068
value 1068
stocks 118
stock pile 112, 113, 118
uses 116, 120
war surplus, Government disposal 112
world review 121
Aluminum-alloy products, secondary, production 1069
Aluminum-base scrap, production 1070
stocks 1071
Aluminum compounds, foreign trade 182
Aluminum industry, annual review 111
reconstitution 113
technologic developments 120
Aluminum ingot, secondary, production 1069
Aluminum oxide, producers 107
production 93, 105, 107
stocks 108
Aluminum plants, Government, sale 114
rated annual capacity 114
Aluminum salts, production 180
Alunite, source 1026
Amblygonite, prices 1290
source 1289
American Gas Association, study, natural-gas reserves 808, 838
American Petroleum Institute, petroleum reserves, estimate 877
American Society for Testing Materials, specifications, cement, revision 228
Ammonia, foreign trade 863
production 862
recovery 447
Ammonia liquor, production 448
Ammonia plants, wartime, disposal 864
Ammonium, sales 447, 448
Ammonium sulfate, price control 447
production 862
yield 404, 405, 445
Amosite, sources 143
stock pile 144
Amphibole, production 143
sales 143, 144
Andalusite, stocks, large 1288
Anhydrite, imports 597
use, as substitute for limestone in cement 228
Anthracite, as source of energy 276, 278, 279
as source of heat 379
"bootleg," purchase by anthracite industry 357, 368
classification 350, 359, 364
competitive fuels 378, 379
consumption 350, 351, 358, 366, 377, 378
culm-bank, put through breakers 357, 359, 360, 365
distribution 350, 351
dredge, production 350, 351, 357, 358, 359, 360, 388
foreign trade 349, 350, 355, 366, 388, 389

Page

Anthracite—Continued
mechanical cutting 350, 366, 388
mechanical loading 350, 366, 385, 386
mechanical mining, Bureau of Mines research 354
mechanical stokers, sales 351, 380
mining methods 385
prices 350, 352, 380, 381, 382, 383
production 295, 349, 350, 351, 356, 357, 359, 360, 364, 365, 366, 390
by weeks and months 351, 364, 365
loss through strikes 349, 350
per man 350, 366
sales realization 350, 368, 369
salient statistics 350, 351
shipments 349, 350, 351, 358, 361, 362, 364, 371, 373, 375, 376, 377
sizes, shipped from breakers 361, 364
stocks 350, 351, 380
stripping operations 350, 366, 386, 387
value per ton 350, 352, 366, 370, 380, 381, 383
washery, production 350, 357, 359, 360
Anthracite Committee, activities 353, 383
Anthracite Conference, Fifth Annual, transactions 354
Anthracite fines, utilization in fuel briquets 530, 535
Anthracite Flood Prevention Section, Bureau of Mines, work 354
Anthracite industry, annual review 349
labor data 350, 352, 353, 366, 383, 384
outlook 355
Anthracite Institute, activities 353, 354
Anthracite mines, "bootleg," men employed 368
days operated 350, 366, 384
man-days of work 350, 366, 384, 385
mechanization data 350, 366, 385, 386
men employed 79, 82, 350, 352, 354, 366, 383, 384
Anthracite miners, injuries 79, 82
Anthratube, operation 354
Antimonial lead. *See* Lead, antimonial.
Antimony, foreign trade 128, 129, 133
prices 128, 129, 132
price control 132
primary, consumption 129, 131
production, mine 129
smelter 130
uses 131
salient statistics 129
secondary, annual review 1088
preference orders 1089
price control 1089
recovery 129, 131, 1065, 1088
source 1088
value 1088
stocks 128, 132
stock pile, decrease 128
world review 134
Antimony concentrates, production 128
Antimony industry, annual review 128
Antimony metal, production 130
Antimony ores, production 129
Aplite, producers 498
uses 498
Aplite rock, grindability, effect of calcination 498
Aquamarine, popularity, increase 554
Argentina, borates, production 750
cement, data 230, 231, 233
Government reorganization, results 1580
iron ore, data 619, 622
lead, data 683, 685, 1581
minerals, review 1580
petroleum, production 1581
solid fuels, production 1581
Steel-Making Plan, details 1580
sulfur, data 1142, 1143, 1144
tungsten, data 1201, 1202, 1204
zinc, data 1261, 1263, 1264
Arizona, asbestos, sources 144
bituminous-coal industry, data 290, 296, 297, 300, 305, 320, 326
Cochise County, metals, production 1316, 1319, 1320, 1321, 1322
copper, production 1311, 1312, 1313, 1314, 1315, 1316, 1317, 1318, 1319, 1320, 1321, 1322
copper ore bodies, discovery 458
fluorspar, data 509, 510, 511, 514
Gila County, metals, production 1316, 1319, 1320, 1321, 1322, 1325

Page

Arizona—Continued
gold, production 1311, 1312, 1313, 1314, 1315, 1316, 1317, 1318, 1319, 1320, 1321, 1322
Graham County, metals, production 1316, 1319, 1320, 1321, 1322, 1325, 1327
Greenlee County, metals, production 1316, 1319, 1320, 1321, 1322, 1327
lead, production 1311, 1312, 1313, 1315, 1316, 1317, 1318, 1319, 1320, 1321, 1322
"marekanite," production 547
Maricopa County, metals, production 1316, 1321, 1322, 1328
mercury, production 770, 771
metallurgic industry, review 1318
minerals, production 28, 31
value 20, 31
mining industry, review 1316
Mohave County, metals, production 1316, 1319, 1320, 1321, 1322, 1328
molybdenum ores, data 798, 799
nonferrous metals, production, annual review 1311
ore, classification 1317
Pima County, metals, production 1316, 1319, 1320, 1321, 1322, 1329
Pinal County, metals, production 1316, 1319, 1320, 1321, 1323, 1330
Santa Cruz County, metals, production 1318, 1319, 1320, 1321, 1323, 1332
silver, production 1311, 1312, 1313, 1314, 1315, 1316, 1317, 1318, 1319, 1320, 1321, 1322.
tungsten, data 1194, 1195, 1196
vanadium ores, deliveries 1234
Yavapai County, metals, production 1316, 1319, 1320, 1321, 1323, 1332
Yuma County, metals, production 1316, 1319, 1320, 1321, 1323, 1335
zinc, production 1311, 1312, 1313, 1315, 1316, 1317, 1318, 1319, 1320, 1321, 1322.
Arkansas, barite, data 161, 163, 164
bauxite, review 176
bituminous-coal industry, data 272, 273, 285, 290, 293, 295, 296, 297, 300, 305, 306, 307, 313, 314, 318, 319, 320, 323, 324, 327.
lead, production 1370, 1371
manganese ore, data 754, 755
mercury, production 770, 771
minerals, production 28, 33
value 20, 33
natural gas, review 809, 811, 812, 813, 814
nonferrous metals, production, review 1371
petroleum industry, review 878, 880, 882, 883, 884, 885, 905, 907, 909, 911, 913, 915, 917, 918, 919, 922, 923, 931, 941, 945, 948, 950, 954, 958, 965, 968, 973, 977.
zinc, production 1370, 1371
Army and Navy Munitions Board, purchases, manganese ore 753
Arsenic, stocks 139
stock pile 139
white, consumption 137, 138
foreign trade 137, 140
prices 137, 139
price control 139
production 137, 138, 141
uses 138
world review 141
Arsenic industry, annual review 137
Arsenicals, foreign trade 140
Asbestos, blue, sources 143
consumption 143, 145
foreign trade 143, 147, 148
market conditions 146
prices 146
sales 143, 144
salient statistics 143
world review 149
Asbestos deposits, discoveries 147
Asbestos industry, annual review 143
Asbestos products, foreign trade 143, 145, 149
new 146
Asbestos substitutes, development 147
Asia. *See* Bikini, Marshall Islands; British Malaya; Burma; Ceylon; China; India; Japan; Korea; Malaya; Manchuria; Netherlands East Indies; Siam; Turkey; Union of Soviet Socialist Republics.

Page

Asphalt, manufactured. *See* Petroleum asphalt.
natural, distribution 157
foreign trade 158
sales 152
See also Petroleum asphalt.
Asphalt industry, annual review 152
Atomic bombs, tests at Bikini 1206
use of uranium in 1206
Atomic bomb project, funds appropriated 1206
Atomic energy, control, by congressional action 1206
conversion to usable power, Compton-Jeffries statement 1218
CPA controls 1216
Government regulations 1212
international control, under United Nations 1216
Senate committee on, hearings 1215
Atomic Energy Act, abstracts 1213
passage 1
provisions 1206
Atomic Energy Commission, establishment 9, 1213
members 1215
regulations on possession of uranium and thorium 1216
transfer of funds to 1206
United Nations, international safeguards, adoption 1205
Atomic power, industrial, contracts for development 1221
Australia, aluminum, data 121
bauxite, data 182, 183
gold, data 583, 587
lead, review 682, 683, 685, 686
magnesite, production 741
magnesium, data 731
mica, data 794, 795
opal, deposits 554
tantalite, data 1275
Tasmania, cadmium, data 196
titanium concentrates, data 1187, 1189
tungsten, data 1200, 1201, 1202, 1204
uranium minerals, data 1230
zinc, data 1261, 1263, 1264
zirconium concentrates, production 1283
Austria, aluminum, data 121, 122
copper, data 479, 480, 481
lead, data 685, 686
magnesite, production 741
molybdenum, production 803
radium plant, capacity 1278
uranium minerals, data 1228
Aviation gasoline, annual review 934
demand 934
foreign trade 934
production 934
salient statistics 935

B

Baddeleyite, data 1283
Bahamas, minerals, review 1562
petroleum, exploration 1562
salt, extraction 1562
Ball clay, annual review 251
consumption 248
foreign trade 252
prices 252
production 247, 251
sales 248, 252
uses 252
Barbados, minerals, review 1562
natural gas, production 1562
petroleum, production 1562
Barite, crude, consumption 162
foreign trade 162, 166
prices 162, 165
producers, list 164
production 162
crushed. *See* Barite, ground.
ground, foreign trade 162, 166
prices 162, 169
sales 162, 168
price control, removed 169
salient statistics 162
tariff reduction, request 163
uses 165
world review 166

Page

Barite industry, annual review 161
Barium, producers 1266
production 1266
Barium chemicals, foreign trade 162, 173
price 172
production 162, 170, 171
sales 162, 171
Barium metals, uses 1266
Basalt, crushed, sales 1122
sales 1103, 1105, 1107, 1109
Battelle Memorial Institute, tests, concentrating taconites 613
Battery industry, manganese ore, consumption 764
Bauxite, consumption 174, 179
foreign trade 174, 175, 181
prices 181
processed, recovery 176, 178
production 174, 175, 176, 183
reserves 178
salient statistics 174
shipments 176, 178
stocks 174, 180, 181
stock pile 180
world review 182
Bauxite industry, annual review 174
Beehive coke. *See* Coke, beehive.
Belgian Congo, cobalt, production 397, 399
copper, review 459, 475, 476, 480, 481
tantalite, production 1274
tin, purchasing agreement, exploration 1161
uranium minerals, data 1224, 1227
uranium-radium deposits, exploration 1278
Belgium, cement, data 232, 234
copper, data 477, 480, 482
Belgium, uranium minerals, data 1228
Bentonite, annual review 253
consumption 248
deposits, location 254
exports 255
prices 255
production 247, 253
sales 247, 248, 254
uses 249, 253
Benzol, production 447, 448
supply 873, 874, 876
Bermuda, limestone, production 1562
Beryl, consumption 1267
prices 1268
production 554
Beryllium, annual review 1266
foreign trade 1268
production, mine 1266
refineries, list 1267
uses 1267
world review 1268
Beryllium concentrates, shipments 1267
Beryllium ore, stocks 1268
Bessemer converters, consumption of ferrous scrap and pig iron 652
Bikini, Marshall Islands, atomic bomb tests 1206
Bismuth, consumption 187, 188
foreign trade 188
prices 188
production 187, 189
stocks 188
stock pile 188
uses 187
world review 189
Bismuth industry, annual review 187
Bitumens industry, annual review 152
Bituminous coal, as source of energy 275, 276, 277, 278, 279
charged into coke ovens 403, 409, 419, 420, 424
competitive fuels 266, 275, 276, 278, 279
consumption 265, 269, 273, 274
distribution 265, 280, 292, 326
foreign trade 343, 344, 345, 346
fuel efficiency 265, 269, 274, 275
loaded for shipment 280, 284, 290, 292, 301, 326
mechanical cleaning 265, 269, 287, 320, 322, 323, 324
mechanical loading 269, 284, 315, 316, 317, 318, 319, 320
equipment, sales 269, 315, 316
mining methods 305, 323

Page

Bituminous coal—Continued
production 264, 265, 268, 269, 270, 271, 272, 284, 285, 286, 288, 289, 290, 292, 294, 295, 296, 305, 314, 318, 320, 322, 325, 326, 346.
by weeks and months 270, 271
per working day 268, 271, 272, 284, 290, 292, 294, 307, 326
salient statistics 269, 284
stocks 265, 269, 282
value per ton 269, 273, 286, 290, 292, 298, 326
Bituminous-coal industry, annual review 264
growth 286
work stoppage, effect on coke industry 401, 407
Bituminous-coal mines, capacity 265, 284, 286
coal-cutting machines, number 306
labor data 265, 272, 283, 284, 287, 290, 292, 299, 300, 307, 326
labor strikes, days lost due to 287
man-days of labor 290, 292, 300, 307, 326
man-hour data, conversion to portal-to-portal basis 80
mechanization 265, 283, 287, 306, 307, 313, 314, 315
men employed 79, 81, 269, 284, 286, 290, 292, 299, 307, 313, 326
number 286, 290, 292, 296, 313, 318
power-drilling operations 314
size 296
stripping operations 269, 284, 287, 288, 307, 313, 326
work days, length 300, 301
number 272, 284, 287, 290, 292, 294, 300, 307, 313, 326
Bituminous-coal miners, injuries 80, 81
output per man 283, 287, 290, 292, 313, 326
Bituminous rock, sales 152
value 152
Blanc fixe, foreign trade 173
price 172
Blast furnaces, consumption of ferrous scrap and pig iron 656
number 630
Blast-furnace cement, development 227
Bluestone, production 470
sales 1115
Bolivia, antimony, data 135, 1582
bismuth, data 190, 1582
columbite, production 1274, 1582
copper, production 1582, 1583
gold, exports 1583
labor difficulties 1581
lead, data 682, 683, 686, 1582, 1583
minerals, exports, value 1581
production 1582
review 1581
nonmetals, production 1582, 1584
petroleum, production 1582, 1584
tin, review 1161, 1163, 1172, 1173, 1174, 1582, 1583
tungsten, data 1200, 1201, 1202, 1204, 1582, 1584
zinc, production 1582, 1583
Borates, production 749, 750
Borax, prices 750
Boron, annual review 1269
producers, list 1269
uses 1270
Boron ferro-alloys, shipments 1269
Boron minerals, producers, list 749
salient statistics 749
Bort, price 92
See also Diamonds, industrial.
Brackelsberg furnaces, consumption of ferrous scrap and pig iron 655
Brass, foreign trade 478
Brass ingot, price control 1078
production 1075
Brass scrap, foreign trade 1079
shipments 1078
stocks 1078
Brazil, aluminum, production 120, 122, 1585, 1586
apatite, data 1585, 1589
aquamarine, production 554
arsenic, data 1585, 1587
baddeleyite, exports 1283
barite, review 166, 167, 1585, 1588
bauxite, data 181, 183
beryllium concentrates, exports 1585, 1586
cement, data 230, 231, 233
chromite, data 241, 243, 244, 245
production 1585, 1586
coal, production 1585, 1589
constitution, effect on mining industry 1586

Page

Brazil—Continued
diamonds, review 1585, 1588
gem stones, data 554, 555, 1585, 1589
gold, data 582, 586, 1585, 1586
graphite, data 1588
iron ore, data 619, 622, 623, 1585, 1587
lead, production 1587
manganese, production 1585, 1587
marble, production 1585, 1588
mica, data 783, 792, 793, 794, 795, 796, 1585, 1589
mica-tourmaline deposit 555
minerals, production 1585
review 1584
monazite, exports 1585, 1589
nonmetals, production 1588
petroleum, production 1585, 1589
phosphate rock, data 1585, 1589
pig iron, production 1585, 1587
quartz crystal, exports 1585, 1589
spodumene, data 555
steel plants, construction 1587
tantalite, exports 1274
tin, data 1587
titanium, exports 1585, 1588
tungsten, data 1200, 1201, 1203, 1204, 1585, 1588
uranium minerals, data 1225, 1226
zirconium concentrates, export 1585, 1588
Breccia, foreign trade 1134
British Guiana, bauxite, review 181, 183, 1590
diamonds, production 1590
gold, production 1590
granite, production 1591
minerals, review 1590
British Honduras, limestone, production 1575
British Malaya, tin, review 1159, 1169, 1170, 1173, 1174, 1175
British West Indies, minerals, review 1562
Bromides, sales 744
Bromine, sales 744
sources 744
Bromine plants, list 744
Bronze, foreign trade 478
Bronze ingot, price control 1078
production 1075
Brown iron ore, production 601, 603, 605, 607
Brown rock, prices 993
Brucite, as source of magnesium compounds 740
Building industry, effect of Veterans' Emergency Housing Act 588
Bureau of Mines, anthracite research 354
investigations, strategic minerals, molybdenum 799
tin 1162
studies, concentrating taconite 613
tests, low-grade coal, in briquets 536
Bureau of Mines-American Gas Association method, for determining carbonizing properties of coal 442
Building gravel, sales 1047, 1052
Building sand, sales 1047, 1049
Bulgaria, uranium, deposit 1228
Burma, lead, data 685, 686
silver, data 584, 587
tin, review 1173, 1177
Burrstones, foreign trade 109
Butane, production 846, 847
sales 850, 851
supply 846
Butane-propane mixtures, production 846
sales 850, 853
source 853
Byproduct coke. *See* Coke, oven.

C

Cadmium, consumption 191, 193
foreign trade 191, 194
Government regulations 191
prices 191, 194
price control, removal 191
production 191, 192
salient statistics 191
secondary, producers, list 193
shipments 192
stocks 191, 194
stock pile 191
tariff 192
uses 193

Page

Cadmium compounds, production 191, 193
Cadmium industry, annual review 191
Cadmium metal plants, list 193
Caicos Island, salt, production 1562
Calcium, review 1270
Calcium arsenate, price 139
Calcium chloride, foreign trade 743
sales 743
Calcium chloride plants, list 744
Calcium-magnesium chloride, sales 743
Calcium metal, foreign trade 1271
price 1270
production 1270
uses 1270
Calcium molybdate, uses 504
Calcium-silicon, foreign trade 1271
California, Amador County, metals, production 1345, 1349, 1351, 1352, 1353
asbestos, sources 144
barite, reserves 163
Butte County, metals, production 1345, 1349, 1351, 1352, 1353
Calaveras County, metals, production 1345, 1349, 1350, 1351, 1353, 1357
chromite, production 239
copper, production 1336, 1337, 1338, 1344, 1345, 1348, 1349, 1350, 1351, 1353
El Dorado County, metals, production 1345, 1349, 1350, 1353, 1357
fluorspar, data 512, 514
Fresno County, metals, production 1345, 1349, 1353, 1358
gold, production 1336, 1337, 1338, 1339, 1340, 1342, 1344, 1345, 1348, 1349, 1350, 1351, 1353
gold mines, leading, list 1341
Humboldt County, metals, production 1345, 1353, 1358
Imperial County, metals, production 1345, 1349, 1353, 1358
Inyo County, metals, production 1345, 1349, 1350, 1351, 1353, 1358
iron-ore industry, data 603, 604, 605, 606, 607, 609, 614, 615, 617, 618
Kern County, metals, production 1345, 1349, 1354, 1359
lead, production 1336, 1338, 1344, 1346, 1348, 1349, 1350, 1351, 1353
lode mines, production 1338, 1342
Los Angeles County, metals, production 1345, 1354, 1360
magnesium compounds, data 739
Mariposa County, metals, production 1345, 1349, 1350, 1354, 1560
Merced County, metals, production 1345, 1354, 1360
mercury, review 769, 770, 771
metallurgic industry, industry 1348
minerals, production 28, 34
value 20, 34
mining industry 1347
Mono County, metals, production 1345, 1349, 1351, 1354, 1361
natural gas, review 809, 811, 812, 813, 814
natural gasoline, data 838, 840, 842, 844, 848
Nevada County, metals, production 1345, 1349, 1351, 1354, 1361
nonferrous metals, production, annual review 1336
Orange County, metals, production 1345, 1350, 1354, 1361
ore, classification 1347
petroleum industry, review 873, 874, 878, 880, 882, 883, 884, 885, 886, 905, 907, 908, 909, 911, 913, 915, 916, 917, 918, 919, 922, 923, 931, 940, 941, 945, 948, 949, 954, 958, 965, 968, 972, 973, 975, 976, 977
Placer County, metals, production 1345, 1349, 1351, 1354, 1362
placer mines, production 1338, 1342, 1345, 1346
Plumas County, metals, production 1345, 1349, 1350, 1351, 1354, 1362
potash, review 1024
pyrites, data 1146
Sacramento County, metals, production 1345, 1354, 1362
salt, data 1033
San Bernardino County, metals, production 1345, 1349, 1351, 1355, 1363

Page

California—Continued
San Francisco County, metals, production 1345, 1355, 1363
San Joaquin County, metals, production 1345, 1355, 1363
Shasta County, metals, production 1345, 1349, 1350, 1351, 1355, 1364
Sierra County, metals, production 1345, 1349, 1350, 1351, 1355, 1364
silver, production 1336, 1337, 1338, 1342, 1344, 1346, 1348, 1349, 1350, 1351, 1353
silver mines, leading, list 1343
Siskiyou County, metals, production 1345, 1349, 1355, 1365
sodium carbonate, production 746
Stanislaus County, metals, production 1345, 1365
sulfur, data 1137
tremolite, production 143
Trinity County, metals, production 1345, 1349, 1351, 1356, 1365
tungsten, review 1194, 1195, 1196
Tuolumne County, metals, production 1345, 1349, 1350, 1356, 1366
University of, analyses of nuclear power 1219
Yuba County, metals, production 1345, 1349, 1356, 1366
zinc, production 1336, 1338, 1344, 1346, 1348, 1349, 1350, 1351, 1353
Canada, aluminum, review 116, 119, 122
anthracite, data 355, 356, 388, 389
arsenic, data 141, 142
asbestos, review 143, 147, 148, 149, 150
barite, review 166, 167
bismuth, data 188, 190
cadmium, data 195, 196
cadmium metal, trade agreement 192
calcium, data 1271
coal, data 344, 346
cobalt, data 397, 398, 399
copper, review 459, 476, 477, 479, 480, 482
feldspar, data 490
fluorspar, data 509, 522, 523
gold, review 581, 582, 585
gypsum, data 598, 599
iron ore, data 602, 619, 622, 623
lead, review 682, 683, 684, 685, 687
magnesium, data 731, 732
mercury, data 777, 778, 780
mica, data 793, 794, 795, 796
molybdenum ore, data 798, 802, 803
nickel, review 856, 858, 859, 860
platinum metals, data 1013, 1014, 1015, 1016
Saskatchewan, potash beds, discovery 1019
selenium, production 1281
silver, review 581, 584, 585
soapstone industry, review 1157
talc industry, review 1157
tantalum, data 1275
tellurium, production 1281
uranium minerals, review 1224, 1226
uranium-radium mine, operation 1278
zinc, review 1261, 1263, 1264
Carbon abrasives, natural, review 106
Carbon-14, potential medical uses 1222
Carbon black, demand 197, 203
foreign trade 198, 205, 206
manufacture from natural gas 830
prices 198, 205
price control, removal 205
production 197, 198, 200, 201
sales 198, 203
salient statistics 198
stocks 197, 204
Carbon-black industry, annual review 197
trends 199
Carbon-black plants, capacity 202
number 202
Carbonate ore, production 601, 603, 604, 607
Carnegie Endowment Committee on Atomic Energy, analyses of nuclear power 1219
Carnotite, prices 1223
Carnotite concentrates, shipments 1207
Carnotite ore, shipments 1207
use as source of uranium 1207
Celestite, demand, decrease 1296
foreign trade 1296
prices 1296

Page

Celestite—Continued
sales 1296
uses 1296
Cement, consumption 208, 229
foreign trade 208, 229
hydraulic, foreign trade 209, 230, 231
world review 231
natural, production 208, 228
shipments 208, 228
stocks 208, 228
price control 209
production 207, 208, 231
salient statistics 208
specifications, revision 228
stocks 207, 208
Cement industry, annual review 207
technologic developments 227
Cement plants, rehabilitation 208
Cement quarries, employment, data 86
Cement quarry workers, injuries, data 86
Central America, coal, foreign trade 344
Central States, copper, production 1367, 1368, 1369, 1370, 1375
lead, production 1367, 1368, 1369, 1370, 1371, 1373, 1377, 1378, 1380, 1383, 1385
metallurgic review 1371
mining industry, review 1371
nonferrous metals, production, annual review 1367
silver, production 1367, 1368, 1369, 1375
zinc, production 1367, 1368, 1369, 1370, 1371, 1373, 1374, 1377, 1378, 1380, 1383, 1384, 1385
Cerium alloy, foreign trade 1271
producers 1271
production 1271
world review 1272
Cerium metal, price 1272
Ceylon, cement, data 235
sapphire, production 554
uranium minerals, data 1230
Chain-reacting piles, for producing fissionable metals, location 1205
Chalcedony, deposits 546
Chasers, sales 100
Chile, borates, production 750
cement, data 230, 231, 233
coal, production 1591, 1593
copper, review 476, 477, 479, 480, 484, 1591, 1592
gold, production 1591, 1592
iodine, foreign trade 745
manganese ore, data 762, 764, 765, 1591, 1592
mercury, production 1591, 1592
minerals, production 1591
review 1591
molybdenum concentrates, data 802, 803, 1591, 1592
nitrates, review 863, 1591, 1592
petroleum, production 1593
pig iron, production 1591, 1592
silver, production 1591, 1592
sulfur, data 1142, 1143, 1144
China, antimony, data 135
arsenic, data 141, 142
bismuth, data 190
cement, data 230, 232, 235
Formosa, aluminum, data 122, 123
jade, investment in 554
China clay, annual review 249
consumption 248
foreign trade 247, 250
prices 250
production 249
sales 250
uses 248
Chromite, consumption 237, 240
deposits, exploration and development 239
foreign trade 237, 243, 244
prices 243
price control, removal 238, 243
Government regulations 238
production 237, 238, 239
salient statistics 237
shipments 237, 238, 239
stock pile, allocation 238, 241
world review 244
Chromium industry, annual review 237
Chrysotile, production 143
sales 143, 144

Page

Civilian Production Administration. *See* CPA.
Clay, blue, imports 247
consumption 248
foreign trade 247, 248
sales 247, 248
salient statistics 247
uses 248
Clay industries, annual review 247
technologic developments 263
Clay products, annual review 259
shipments 259, 260, 261
Coal, as fuel for power stations, cost, comparison with nuclear power stations, estimate 1220
carbonizing properties, determination, by Bureau of Mines-American Gas Association method 442
competitive costs with plutonium 1220
See also Anthracite; Bituminous coal; Coke; Coking coal; Fuel briquets; Lignite; Packaged fuel; Peat.
Coal brasses, production 1146
Coal-chemical materials, annual review 445
production 404, 448
salient statistics 404, 448
value 404, 448
yield per ton of coal 404
Coal mines, men employed 74, 75, 79
Coal Mines Administration, organization 10
Coal miners, injuries 74, 75, 79
Cobalt, consumption 392
demand, postwar 391
foreign trade 392, 397
price control, removal 392
sources, domestic 394
uses 391
world review 398
Cobalt high-temperature alloys, analyses 393
Cobalt industry, annual review 391
Cobalt ore, production, mine 392, 394
shipment 394
Cobalt products, production 396
shipment 396
Coke, beehive, distribution 432, 433
production 401, 405, 406, 409, 411, 412, 413, 415, 416, 437, 444
shipments 431
stocks 437, 438
byproduct. *See* Coke, oven.
consumption 402, 404, 433
in manufacture of pig iron 434
disposal 402, 405
foreign trade 402, 404, 405, 440
foundry, stocks 438
furnace, stocks 438
low-temperature, salient statistics 408
medium-temperature, salient statistics 408
oven, distribution 432, 433
plants, capacity 402, 418
production 401, 405, 406, 409, 411, 412, 413, 414, 415, 416, 444
shipments 431
stocks 401, 404, 437, 439
prices 402, 404, 405, 406, 409, 439
price control 407
production, by months and weeks 411
sales 403
salient statistics 403, 405, 409
stocks 402, 404, 405, 409, 437
yield per ton of coal 403, 429
See also Petroleum coke.
Coke breeze, disposal 404, 430
production 403, 408, 409, 430
stocks 404, 438
value 404, 430
Coke industry, annual review 400
CPA, direction 407
Government regulations 407
SFAW, control, relaxation 407
technologic developments 432
Coke ovens, beehive, capacity 402
coal charged, consumption 403, 405, 409, 419, 420, 421, 422, 424
cost 405, 419, 421
preparation 422, 424
sources 423
value 403, 409, 421

Page

Coke ovens—Continued
number 403, 405, 406, 408, 409, 417, 418
vertical slot-type, number 416, 418
work stoppage, due to steel strike 400
yield, average 403, 406, 409
Coke-oven gas, production 404, 446
value 404, 405, 446
yield 404, 405, 445
Coke plants, employment, data 74, 75, 88, 89, 404
man-hours of work 404
oven, capacity 418, 419
workers, injuries, data 75, 88, 89
Coke screenings, disposal 404
production 403, 409
stocks 404, 438
value 404
Coking coal, price 402
stocks 437
Colombia, barite, production 1593, 1594
coal, data 1594
emerald, data 553, 554
gold, data 582, 586
minerals, production 1593
review 1593
petroleum, production 1593, 1594
platinum metals, data 1013, 1014, 1015, 1016, 1593, 1594
precious metals, production 1593, 1594
salt, production 1593, 1594
Colorado, Adams County, metals, production 1390, 1396, 1397
bituminous-coal industry, data 272, 273, 285, 290, 295, 296, 297, 300, 305, 306, 307, 313, 314, 318, 319, 320, 323, 324, 327.
Boulder County, metals, production 1390, 1393, 1394, 1395, 1396, 1397
Chaffee County, metals, production 1390, 1393, 1394, 1395, 1396, 1397, 1399
Clear Creek County, metals, production 1390, 1393, 1394, 1395, 1396, 1397, 1400
copper, production 1387, 1388, 1389, 1391, 1392, 1393, 1394, 1395, 1396, 1397
Cripple Creek district, metals, production 1390, 1393, 1398, 1410
Custer County, metals, production 1390, 1394, 1395, 1396, 1397, 1401
Dolores County, metals, production 1390, 1394, 1395, 1396, 1397, 1401
Eagle County, metals, production 1390, 1394, 1395, 1396, 1397, 1401
El Paso County, metals, production 1402
fluorspar, review 509, 510, 512, 514, 515
Fremont County, metals, production 1390, 1394, 1395, 1396, 1397, 1402
Garfield County, metals, production 1390, 1394, 1395, 1397, 1402
Gilpin County, metals, production 1390, 1393, 1394, 1395, 1396, 1397, 1402
gold, production 1387, 1388, 1389, 1390, 1392, 1393, 1394, 1395, 1396, 1397
Gunnison County, metals, production 1390, 1393, 1394, 1395, 1396, 1397, 1403
hematite, data 603, 604, 605, 606, 607, 609, 614, 615, 617, 621
Hinsdale County, metals, production 1390, 1396, 1397, 1403
Jefferson County, metals, production 1390, 1394, 1395, 1398, 1403
Lake County, metals, production 1390, 1393, 1394, 1395, 1396, 1398, 1404
lead, production 1387, 1388, 1390, 1391, 1392, 1393, 1394, 1395, 1396, 1397
Leadville district, metals, production 1398, 1404
La Plata County, metals, production 1390, 1393, 1396, 1398, 1405
metallurgic industry 1392
minerals, production 28, 36
value 20, 36
Mineral County, metals, production 1390, 1394, 1395, 1396, 1398, 1405
mining industry, review 1391
Molybdenum ore, review 799
Montezuma County, metals, production 1390, 1393, 1395, 1398, 1405
Montrose County, metals, production 1390, 1396, 1398, 1406
natural gas, review 809, 811, 812, 813, 814, 815

Page

Colorado—Continued
nonferrous metals, production, annual review 1387
ore, classification 1392
Ouray County, metals, production 1390, 1393, 1394, 1395, 1396, 1398, 1406
Park County, metals, production 1390, 1394, 1395, 1396, 1398, 1406
petroleum industry, review 878, 880, 882, 883, 884, 885, 887, 905, 907, 909, 911, 913, 915, 917, 918, 922, 941, 949, 958.
Pitkin County, metals, production 1390, 1394, 1395, 1396, 1398, 1407
Rio Grande County, metals, production 1390 1393, 1395, 1398, 1407
Routt County, metals, production 1390, 1394, 1395, 1398, 1407
Saguache County, metals, production 1390, 1394, 1395, 1396, 1398, 1407
San Juan County, metals, production 1390, 1394, 1395, 1396, 1398, 1408
San Miguel County, metals, production 1390, 1393, 1394, 1395, 1396, 1398, 1408
silver, production 1388, 1389, 1390, 1391, 1392, 1393, 1394, 1395, 1396, 1397
sulfur, data 1137
Summit County, metals, production 1390, 1393, 1394, 1395, 1396, 1398, 1409
Teller County, metals, production 1390, 1393, 1398, 1410
tungsten, review 1194, 1195, 1197
turquoise, production 547
vanadium, production 1234
zinc, production 1387, 1388, 1389, 1391, 1392, 1393, 1394, 1395, 1936, 1397.
Columbite, stock pile 1273
world reivew 1274
Columbium, annual review 1272
prices 1273
shipments 1272
uses 1273
Columbium ores, foreign trade 1273
Compton-Jeffries statement, on conversion of atomic energy to usable power 1218
Concrete, sales 1118
Concrete houses, utilization of cement in 227
Connecticut, minerals, production 28, 37
value 20, 37
Controls, Temporary, Office of. *See* OTC.
Copper, Bureau of Mines publications, list 460
cast in forms, production 470
consumption 458, 470, 471
foreign trade 459, 460, 475
Geological Survey publications, list 461
Premium Price Plan, bonus payments 473
prices 458, 459, 460
price control 461
primary, production, mine 458, 459, 462, 463, 464, 479
refinery 459, 468, 469
smelter 459, 460, 468, 480
salient statistics 459
secondary, analysis 1075
annual review 1074
consumption 1076
foreign trade 1079
prices 1078
price control 1077
recovery 458, 459, 469, 470, 1065. 1074, 1075
shipments 1078
stock pile, attempts to market 1077
stocks 459, 472
stock pile 458, 461, 472
world review 479
Copper-alloy products, production 1075
Copper districts, leading, list 464
Copper industry, annual review 457
Government regulations 461
manpower shortage 457
Copper Institute, data 472
Copper mills, employment, data 90
Copper-mill workers, injuries, data 90
Copper mines, employment, data 84
labor strikes 457
leading, list 465
Copper miners, injuries, data 84
Copper ores, recoverable content 466

Page

Copper scrap. *See* Copper, secondary.
Copper sulfate, production 470
Cornwall stone, imports 496
Corundum, foreign trade 92, 105, 109, 110
prices 105
production 105
review 104
industry, domestic, efforts to establish 104
Costa Rica, gold, data 1575
minerals, review 1575
nonmetals, production 1575
petroleum, exploration 1576
silver, data 1575
sulfur, data 1144
CPA, conservation orders, atomic energy 1216
tin 1162
controls, cadmium 191
chromite 238
copper 461
potash industry 1018
direction, coke industry 407
ferrous scrap supplies, distribution 645
import controls, lead 668
tin 1161
limitation orders, lead 668
lead chemicals 692
organization 8
preference orders, antimony, secondary 1089
lead 665
priority control, lead, secondary 1084
production order, tin 1162
ship-breaking program 644
stock pile, aluminum 112, 113, 118
copper, secondary, attempts to market 1077
Creosote oil, production 448
Crocidolite, sources 143
stock piling 144
Crucible furnaces, consumption of ferrous scrap and pig iron 66, 656
Cryolite, artificial, manufacture 524
foreign trade 524
occurrence 524
uses 524
Cuba, asphalt, data 1566
barite, tariff reduction, request 163
chromite, data 1563, 1564
copper, data 1563, 1564
diamond-cutting industry, set-back 1565
gilsonite, exports 1566
iron ore, review 602, 619, 622, 623, 1563, 1564
manganese ore, review 762, 765, 766, 1563, 1564
minerals, review 1563
nickel, review 856, 859, 860, 861, 1564, 1565
petroleum industry, review 1566
precious metals, data 1564, 1565
salt, production 1566
stone industry, data 1566
tungsten, data 1565
Cupola furnaces, consumption of ferrous scrap and pig iron 654
Cyclotron, yield of isotopes 1221
Cyprus, pyrites, data 1148, 1149
Czechoslovakia, pitchblende concentrates, sales 1278
uranium-radium minerals, data 1228

D

Delaware, minerals, production 28, 38
value 20, 38
Denmark, rock salt, discovery 1045
Diamond, alluvial, discovery 547
foreign trade 549
industrial, consumption 550
deposits 106
foreign trade 92, 109, 552, 553
price 92, 552, 553
stock pile 552
uses 106
prices 550
production 551, 552
sales 549
share dealings 550
Diamond-cutting industry, status 549, 551
Diamond industry, annual review 549
Diatomite, occurrence 95
prices 95
review 94

Page

Diatomite—Continued
sales 93, 94
uses 95
Dimension stone, foreign trade 1133, 1134
production 1102
sales 1103
salient statistics 1105
use, trends 1115
value 1102, 1103, 1104, 1105
District of Columbia, minerals, production 28, 38
value 20, 38
Dolomite, as source of magnesium compounds 739
crushed, sales 1128
sales 741
Dominican Republic, bauxite, deposits, exploration 1567
gold, production 1567
gypsum, production 1567
minerals, review 1567
petroleum, exploration 1567
salt, production 1567
Dumortierite, stocks, large 1288

E

Eastern States, copper, production 1413, 1414, 1415, 1417, 1418, 1419, 1420, 1421, 1423
gold, production 1413, 1414, 1415, 1416, 1418, 1420, 1421
lead, production 1413, 1414, 1415, 1417, 1418, 1419, 1421, 1423
metallurgic industry, review 1418
mining industry, review 1417
nonferrous metals, production, annual review 1413
ore, classification 1418
silver, production 1414, 1415, 1416, 1418, 1419, 1420, 1421, 1423
zinc, production 1413, 1414, 1415, 1416, 1417, 1418, 1419, 1420, 1421, 1422, 1423
Ecuador, copper, production 1595
minerals, production 1595
review 1595
petroleum, production 1594, 1596
precious metals, production 1595
salt, production 1596
Egypt, manganese ore, data 765, 766
titanium concentrates, data 1189, 1190
Eire, scrap industry, data 664
Emerald, source 553
Emergency Management, Office for. *See* OEM.
Emery, foreign trade 92, 109
producers 106
prices 106
sales 93, 106
Engine sand, sales 1047, 1051
Epsom salt, source 739
Europe. *See* Austria; Belgium; Bulgaria; Czechoslovakia; Denmark; Eire; Finland; France; Germany; Greece; Hungary; Italy; Netherlands; Norway; Portugal; Spain; Sweden; Switzerland; Turkey; Union of Soviet Socialist Republics; United Kingdom; Yugoslavia.

F

Federal Bureau of Investigation, assignment of funds for atomic investigation 1206
Federal Power Commission, natural-gas pipe lines, construction, approval 808
Federal Supply, Bureau of, stocks, bauxite 174, 180
Federal Trade Commission, cement companies, antitrust order, voiding 209
Feldspar, crude, foreign trade 490
prices 491
production 490, 491
sales 490, 492
uses 494
deposits, depletion 498
location 499
exploration program 498
froth flotation 491
ground, foreign trade 490
prices 495
production 492
sales 490, 492, 493
uses 494
salient statistics 490
world review 499

Page

Feldspar industry, annual review 490
technologic developments 498
Ferro-alloys, consumption 503
foreign trade 505, 506
producers, list 505
production 501, 502
consumption of ferrous scrap 658
shipments 501, 502
supply 501
Ferro-alloys industry, annual review 501
Ferroboron, prices 1270
shipments 504
uses 504
Ferrochromium, consumption 503
foreign trade 504, 506
Ferrocolombium, uses 504
Ferromanganese, consumption 758
foreign trade 506, 751, 761, 762
manufacture, manganese ore used 762
price 760
producers, list 760
production 502, 751, 760, 761
shipments 502, 762
stocks 758
Ferromolybdenum, foreign trade 504
manufacture, process 504
Ferrophosphorus, foreign trade 503
production 502
shipments 502
Ferrosilicon, consumption 503
foreign trade 502, 506
production 502
shipments 502
uses 503
Ferrotitanium, foreign trade 504, 506
production 502
uses 504
Ferrotungsten, consumption 503
foreign trade 503
production 502
shipments 502
Ferrovanadium, foreign trade 504
scources 504
Fertilizers, nitrogenous, for occupied areas, need 865
Filter sand, sales 1047, 1051
Finance, international, status 560
Finland, copper, review 479, 480, 485
molybdenum, production 803, 304
Fire clay, annual review 252
consumption 248
deposits, location 252
foreign trade 247, 252
prices 252
production 252
sales 247, 248, 253
uses 248, 252
Fire sand, sales 1047, 1050
Flagstones, slate, sales 1094
Flint, foreign trade 109, 110
Florida, minerals, production 28, 38
value 20, 38
petroleum industry, review 882, 883, 888, 913, 917, 918, 941, 958, 968
phosphate rock, review 988, 989, 990, 992, 993
titanium ores, production 1183
Flue dust, foreign trade, world review 195
Fluorine, liquefied, marketing 508
Fluorspar, ceramic grade, shortage 508
consumption 507, 513, 514
at steel plants 513
deliveries 508
extraction, rate 509
foreign trade 507, 508, 509, 512, 521
price 508, 514
price control 514
production 507, 509
sales 508, 512
salient statistics 507
shipments 507, 509, 511
stocks 507, 512, 513
uses 511
world review 523
industry, annual review 507
Fluorspar mills, developments 520
Formosa. *See* China.

Page

France, aluminum, data 122, 123
antimony, data 135, 136
bauxite, data 183, 184
cement, data 230, 232, 234
iron, scrap, export 664
lead, data 685, 687
sulfur, data 1142, 1143, 1144
uranium minerals, data 1228
French chalk, foreign trade 1155, 1156
French Guiana, gold, production 1596
French Morocco, cobalt, data 398, 399
nickel, data 398, 399
tungsten, data 1203, 1204
Fuel briquets, binders 532
consumption 527
foreign trade 527, 535
manufacture, by Piersol process 536
production 525, 526, 527, 528, 529
raw fuels 530
salient statistics 527
shape 533
shipments 533
utilization of anthracite fines 530, 535
value per ton 527, 528
weight 533
Fuel-briquet industry, annual review 525, 526
outlook 525
technologic developments 535
Fuel-briquet plants, capacity 529
classification 532
number 525, 528, 529
output 528, 529
Fuel oil, annual review 953, 964
demand 872, 873, 874, 875, 876, 925, 954, 965
foreign trade 925, 954, 956, 965, 966
prices 933, 961, 962, 963, 971, 972
price control 962
production 924, 925, 927, 929, 930, 931, 932, 953, 954
sales 955, 964
salient statistics 925, 954, 965
shipments 965, 966
stocks 925, 954, 962, 965, 972
transfers 925, 954, 965
yields 927
Fuller's earth, annual review 255
consumption 249
deposits, location 255
foreign trade 247, 255
prices 255
production 247, 255, 256
sales 247, 249, 256
uses 249, 255
Fungicides, arsenical, demand 138
Furnaces, electric steel, consumption of ferrous scrap and pig iron 652
open-hearth, consumption of ferrous scrap and pig iron 641
Furnace sand, sales 1047, 1050

G

Gallium, uses 1275
Garnet, abrasive, production 93, 103, 104
deposits 548
foreign trade 109, 110
price 103
producers 103
sales 93, 104
Gasoline, annual review 936
consumption 941
demand 872, 873, 874, 875, 876, 925, 936, 937, 938
distribution 942
foreign trade 925, 936, 937, 938, 947
prices 933, 946
production 846, 872, 924, 925, 926, 927, 929, 930, 931, 932, 936, 937, 938, 939, 940, 941
salient statistics 925, 937, 938
shipments 943
stocks 925, 928, 936, 937, 938, 943
supply 846
yields 927
See also Aviation gasoline.
Gem stones, control, removal 548
foreign trade 548, 549
Government regulations 548
production, domestic 545
Gem-stone industry, annual review 544

Page

Georgia, amphibole, production 144
bauxite, production 176, 177
bituminous-coal industry, data 272, 273, 285, 290, 295, 296, 297, 300, 305, 307, 313, 320, 327
brown iron ore, data 614, 615
gold, production 1416, 1418
kaolin, sales 251
magnesium compounds, data 739
minerals, production 28, 39
value 20, 39
Germanium, price 1276
production 1275
sources 1276
uses 1276
Germany, aluminum, review 122, 123
cement, data 232, 234
copper, review 479, 480, 486
iron ore, data 622, 624
mercury, data 777, 780
mica, synthetic, research 792
magnesium, review 731, 732
radio-grade quartz, synthetic, attempted production 1295
rhenium, as byproduct of copper smelting 1279
selenium, production 1281
sodium metal industry, information 749
titanium industry, review 1190
uranium minerals, data 1229
vanadium, data 1238
zirconium metal, production 1284
Gilsonite, sales 152
value 152
Glass sand, sales 1047, 1049
Glauber's salt, foreign trade 748
production 747
Gold, buying prices, Treasury 558
consumption, industrial 577
foreign trade 558, 559, 579, 580
from base-metal ores, output, reduction, due to labor strike 557
monetary agreements, international 560
prices 559, 578
poduction, cumulative table 576
mill 574
mine 557, 559, 561, 562, 563, 567, 571, 572, 581, 582
placer 558, 559, 575
refinery 575
salient statistics 559
stocks, monetary 559, 578
world review 580
Gold industry, annual review 557
Gold mills, employment, data 90
Gold-mill workers, injuries, data 90
Gold mines, employment, data 83, 84, 85
leading, list 565
Gold miners, injuries, data 83, 84, 85
Gold-mining districts, leading, list 562
Gold-mining industry, WPB control, cessation 557
Gold ore, production 569
Granite, crushed, sales 1122
sales 1103, 1105, 1107, 1108
Granite quarries, employment, data 86, 87
Granite quarry workers, injuries, data 86, 87
Graphite, annual review 1285
foreign trade 1286
prices 1286
production 1285, 1287
shipments 1285
stock pile 1286
Gravel, consumption, trends 1057
foreign trade 1061
preparation 1055
prices 1060
production 1046, 1048, 1059
sales 1046, 1047, 1048, 1049, 1054, 1055, 1057
transportation 1056
Gravel industry, annual review 1026
labor data 1058
technologic developments 1061
Gravel plants, size 1056
Greece, magnesite, production 741
molybdenum, data 803, 804
Green Act, expiration 559
Greenland, cryolite, deposit 524
Greensand, price control, removal 1287
production 1287
Greensand marl, sales 1287

Page

Grinding pebbles, producers 101
production 93
sales 100
Grinding sand, sales 1047, 1050
Grindstones, foreign trade 92, 109, 110
production 93
sales 99, 100
Gross Almerode clay, imports 247
Guatemala, chromite, production 1577
gold, production 1577
iron ore, production 1577
lead, data 1577
mica, production 1577
minerals, review 1577
nonmetals, data 1577
petroleum, law, new 1577
salt, production 1577
sulfur, data 1143, 1144
Gypsum, calcined, production 588, 589, 590, 591
calcining plants 591
consumption 591
crude production 588, 589, 590
foreign trade 588, 597
prices 594
salient statistics 588
uses 591
world review 598
Gypsum board, scarcity 589
Gypsum industry, annual review 588
plant expansions 595
price problems 589
technologic developments 596
Gypsum products, foreign trade 597
sale 588, 591, 592, 593, 594

H

Haiti, bauxite, data 183, 184, 1567
gold, production 1567
minerals, review 1567
petroleum, exploration 1568
salt, production 1586
Hausmanite ore, shipments 754, 756, 757
Hematite, production 601, 603, 605, 607
Hiperco, uses 392
Honduras, antimony, data 135, 136, 1578
gold, production 1578
gold-silver mines, development 1578
iron-ore deposits, exploration 1578
minerals, review 1578
petroleum, exploration 1578
salt, production 1578
silver, data 584, 585
Housing Act, Veterans' Emergency, effect on building industry 588
provisions 626
Hungary, aluminum, data 122, 126
bauxite, data 183, 184
lead, data 685, 687

I

Idaho, Adams County, metals, production 1430, 1435, 1436, 1437
antimony, data 129
Benewah County, metals, production 1430, 1436, 1437
Blaine County, metals, production 1430, 1433, 1435, 1436, 1437
Boise County, metals, production 1430, 1434, 1435, 1436, 1437
Bonner County, metals, production 1430, 1433, 1434, 1435, 1437, 1439
Boundary County, metals, production 1430, 1433, 1434, 1437, 1439
Bonneville County, metals, production 1430, 1437, 1439
Butte County, metals, production 1430, 1433, 1434, 1435, 1437, 1439
Clearwater County, metals, production 1430, 1437, 1440
cobalt, data 395
Coeur d'Alene region, metals, production 1438, 1442
copper, production 1424, 1425, 1428, 1430, 1431, 1433, 1434, 1435, 1437
Custer County, metals, production 1430, 1433, 1434, 1435, 1437, 1440

Page

Idaho—Continued
diamonds, alluvial, discovery 547
Elmore County, metals, production 1430, 1434, 1435, 1437, 1440
garnets, deposits 548
gold, production 1424, 1435, 1426, 1427, 1430, 1431, 1432, 1433, 1434, 1435, 1437
Idaho County, metals, production 1430, 1435, 1437, 1441
lead, production 1424, 1425, 1426, 1427, 1428, 1430, 1431, 1433, 1434, 1435, 1437
Lemhi County, metals, production 1430, 1433, 1934, 1435, 1438, 1441
lode mines, production 1425, 1430
mercury, data 769, 770, 773
metallurgic industry, review 1431
minerals, production 28, 40
value 20, 40
mining industry, review 1431
nonferrous metals, production, annual review 1424
ore, classification 1431
Owyhee County, metals, production 1430, 1434, 1435, 1438, 1441
phosphate rock, review 989, 990, 997, 998, 999, 1234
placer mines, production 1425, 1426, 1430
Shoshone County, metals, production 1430, 1433, 1434, 1435, 1438, 1442
silver, production 1424, 1425, 1426, 1427, 1430, 1431, 1433, 1434, 1435, 1437
tungsten, data 1194, 1195, 1197
Valley County, metals, production 1430, 1433, 1434, 1438, 1448
zinc, production 1424, 1425, 1426, 1427, 1429, 1430, 1431, 1433, 1434, 1435, 1437
Illinois, bituminous-coal industry, data 272, 273, 285, 290, 292, 295, 196, 297, 300, 305, 306, 307, 313, 314, 318, 319, 320, 323, 324, 328
coal, briquetting, by Piersol process 536
fluorspar, review 507, 509, 510, 512, 514, 516
lead, production 1370, 1372
magnesium carbonate, data 739
minerals, production 28, 41
value 20, 41
natural gas, review 809, 811, 812, 813, 814, 816
nonferrous metals, production, annual review 1372
petroleum industry, review 878, 880, 882, 883, 884, 885, 888, 905, 907, 908, 909, 911, 913, 915, 917, 918, 919, 922, 923, 931, 939, 941, 945, 948, 950, 951, 954, 958, 965, 968, 973, 975, 976, 977
pyrites, production 1146
silver, production 1369
tripoli, sales 96
zinc, production 1369, 1370, 1372
Ilmenite, consumption 1183, 1185
foreign trade 1187
prices 1183, 1186
production 1183, 1184
shipments 1184
stocks 1186
world review 1189
India, aluminum, data 122, 126
cement, data 232, 236
mica, review 783, 793, 794, 795, 796
monazite, data 1225, 1230
pyrites, data 1148, 1149
titanium concentrates, data 1187, 1189, 1191
zircon, deposits 1283
Indiana, bituminous-coal industry, data 272, 273, 285, 290, 292, 295, 296, 297, 300, 305, 306, 308, 313, 314, 318, 319, 320, 323, 324, 329.
limestone, sales 1111, 1112, 1113
minerals, production 28, 42
value 20, 42
natural gas, review 809, 811, 812, 813, 814, 816
petroleum industry, review 878, 880, 882, 883, 889, 905, 907, 908, 909, 911, 913, 915, 917, 918, 919, 922, 931, 939, 941, 945, 948, 950, 951, 954, 958, 965, 968, 973, 975, 976, 977.
pyrites, production 1146
Indium, foreign sources 1276
price 1276
producers 1276
production 1276
uses 1276
Insecticides, arsenical, demand 137, 138
production 139

Page

Interior Department, postwar agencies 10
potash exploration, permits for, cessation 1018
Iodine, imports 745
prices 745
price control, removal 745
tincture of, new concentration 745
uses 745
Iodine—131, use to treat hyperthyroidism 1222
Iowa, bituminous-coal industry, data 272, 273, 285, 290, 292, 295, 296, 297, 300, 305, 306, 308, 313, 314, 318, 319, 320, 329.
minerals, production 28, 42
value 20, 42
Iridium, price 1009
recovery 1008, 1009
secondary, recovery 1009
Iron. *See* Pig iron.
Iron blast-furnace slag, labor data 1064
production 1062
sales 1062, 1063
shipments 1064
Iron blast-furnace-slag industry, annual review 1026
Iron industry, annual review 626
Iron mills, employment, data 90
Iron-mill workers, injuries, data 90
Iron mines, employment, data 620
Iron ore, beneficiation 619
consumption 601, 617
foreign trade 601, 602, 619
manganiferous, consumption 763
shipments 755
mined, varieties 605
prices 618
production 600, 601, 602, 603, 604, 605, 606, 607, 608, 622
by pyrites industry 602
salient statistics 601
shipments 601, 602, 605, 607, 610
stocks 600, 601, 612, 617
world review 622
Iron-ore industry, annual review 600
labor data 620
mining methods 604
strikes 600
Iron-ore mines, leading, list 608
employment, data 83
Iron-ore miners, injuries, data 83
Iron oxide pigments, sales 1291
Iron scrap, consumption in ferro-alloys 658
price controls 645
world review 664
Iron-scrap industry, annual review 642
Government regulations 645
Isobutane, production 846
supply 846
Isopentane, production 846
supply 846
Isotopes, definition 1221
radioactivity, as byproducts of fissionable metals 1208
Italy, aluminum, data 119, 122, 126
barite, review 166, 167
bauxite, review 183, 184
iron ore, review 619, 622, 624
lead, data 685, 687
manganese ore, data 765, 766
mercury, review 777, 778, 780
sulfur, data 1143, 1144

J

Jade, investment in 554
shipments 546
Jamaica, bauxite, mining 1562
minerals, production 1562
Japan, aluminum, data 122, 126
barite, review 166, 168
cement, data 232, 236
chromite, review 244, 245
ferrovanadium, data 1238
lead, review 683, 685, 687
magnesium, review 731, 735
mercury, data 780, 781
molybdenum, production 803, 804
pyrites, review 1148, 1149
salt, demand 1045
scrap industry, data 664

Page

Japan—Continued
sulfur, review 1143, 1144
tin, review 1159, 1160, 1166, 1169, 1170, 1173, 1174, 1177
tungsten, review 1201, 1203, 1204
Jasper, red, deposits 546
Jewelry, fashion trends 544
sales 544
Jewelry industry, annual review 544

K

Kansas, bituminous-coal industry, data 272, 273, 285, 290, 295, 296, 297, 300, 305, 306, 308, 313, 320, 323, 324, 330.
lead, production 1370, 1372, 1373
minerals, production 28, 43
value 20, 43
natural gas, review 809, 811, 812, 813, 814, 816
nonferrous metals, production, annual review 1372
petroleum industry, review 878, 880, 882, 883, 885, 890, 905, 907, 908, 909, 911, 913, 914, 915, 917, 918, 919, 922, 923, 931, 939, 941, 945, 948, 950, 954, 958, 965, 968, 973, 975, 976, 977.
salt, data 1033, 1034
zinc, production 1370, 1372, 1373
Kaolin, annual review 249
consumption 248
foreign trade 247, 250
prices 250
production 249
sales 247, 248, 250
Kentucky, bituminous-coal industry, data 272, 273, 285, 292, 295, 296, 297, 300, 305, 306, 309, 313, 314, 317, 318, 319, 320, 323, 324, 330.
fluorspar, review 509, 510, 512, 514, 517
lead, production 1370
minerals, production 28, 44
value 20, 44
natural gas, review 809, 811, 812, 813, 814, 816
nonferrous metals, production, review 1374
petroleum industry, review 878, 880, 882, 883, 891, 905, 907, 908, 909, 911, 913, 914, 915, 917, 918, 919, 922, 923, 931, 939, 941, 945, 950, 954, 958, 965, 968, 973, 975, 976, 977.
zinc, production 1370, 1374
Kerosine, annual review 947
demand 872, 873, 874, 875, 925, 948
foreign trade 925
prices 933, 951, 952
production 924, 925, 927, 929, 930, 931, 932, 947, 948
sales 949, 950
salient statistics 925, 948
stocks 925, 948
yields 927
Korea, cement, data 232, 236
Kyanite, consumption 1288
imports 1288
prices 1288
producers, list 1288
Kyanite minerals, price control, removal 1288

L

Lake Superior district, iron industry, review 610
iron ore, analyses 611
prices 612
production 600, 601, 610, 611
reserves 611
shipments 610
stocks 612
mining industry, developments 612
Land Management, Bureau of, regulations on potash prospecting, amendments 1018
Land pebble, prices 992, 993
Langbeinite, production 1025
Lanthanum metal, price 1272
Lead, antimonial, production 674
secondary production, increase 1089
consumption, CPA limitation 665, 668
foreign trade 665, 666, 667, 682, 683
imports, control 668
Premium Price Plan, bonuses 668, 679, 680
prices 665, 666, 678
price control, removal 666

Page

Lead—Continued
primary, consumption 666, 675, 676
production, mine 665, 668, 669, 670
refinery 666, 667, 671, 673
smelter 671
refined, consumption 675
shipments 677
red. *See* Red lead.
salient statistics 666, 680
secondary, annual review 1081
consumption 666, 673, 1083
prices 1081, 1084
price control 1084
priority control 1084
recovery 666, 673, 1065, 1081
shipments 1082
stocks 1084
stocks 666, 677
stock pile 666, 1083
tariff, Mexican Trade Agreement 668
white. *See* White lead.
world review 685
Lead-alloy products, secondary, shipments 1082
Lead arsenate, price 139
Lead chemicals, limitation order 692
Lead industry, annual review 665
Government regulations 667
labor strikes, reduction of output 666
secondary, labor strike, effect on supply 1083
Lead mines, leading list 672
Lead pigments, distribution 692
foreign trade 691, 705, 706
manufacture, raw materials 703
prices 691, 705
salient statistics 691
shipments 694
Lead pigments industry, annual review 690
Lead refineries, list 673
Lead salts, foreign trade 706
Lead smelters, labor strikes 1241
list 673
Lead sulfate, basic, consumption 697
shipments 695
Lead-zinc mills, employment, data 90
Lead-zinc-mill workers, injuries, data 90
Lead-zinc mines, employment, data 83, 84
Lead-zinc miners, injuries, data 83, 84
Lepidolite, prices 1290
sources, domestic 1289
Light oil, crude, production 447, 448
derivatives 447, 448
yield 404, 405, 445
Lignite, as source of energy 275, 276, 277, 278, 279
competitive fuels 266, 275, 276, 278, 279
consumption 265, 269, 273, 274
distribution 265, 280, 292, 326
fuel efficiency 265, 269, 274, 275
loaded for shipment 280, 284, 290, 292, 301, 326, 340
mechanical loading 269, 284, 315, 316, 317, 318, 319, 320
equipment, sales 269, 315, 316
mining methods 305, 323, 342
production 264, 265, 268, 269, 270, 271, 272, 284, 285, 286, 288, 289, 290, 292, 294, 295, 296, 305, 314, 318, 320, 322, 325, 326, 336, 340, 341.
by weeks and months 270, 271
per working day 268, 271, 272, 284, 290, 292, 294, 307, 326, 340, 341
salient statistics 269, 284, 340, 341
stocks 265, 269, 282
value per ton 269, 273, 286, 290, 292, 298, 326, 340, 341
Lignite-char briquets, gasification tests 536
Lignite industry, annual review 264, 340
Lignite mines, capacity 265, 284, 286
labor data 265, 272, 283, 284, 287, 290, 292, 299, 300, 307, 326, 340, 341
man-days of labor 290, 292, 300, 307, 326, 340, 341
mechanization 265, 283, 287, 306, 307, 313, 314, 315
men employed 269, 284, 286, 290, 292, 299, 307, 313, 326, 340, 341
number 286, 290, 292, 296, 313, 318
power-drilling operations 314
size 296
stripping operations 269, 284, 287, 288, 307, 313, 326, 340, 342, 343
work days, length 300, 301
number 272, 284, 287, 290, 292, 294, 300, 307, 313, 326, 340, 341

Page

Lignite miners, output per man 283, 287, 290, 292, 313, 326, 340, 341
Lime, agricultural uses 716
captive tonnage 710
consumption 717, 718, 719, 721
dolomitic, crushed, sales 1128
foreign trade 708, 722
hydrated, sales 708, 710, 712, 713, 714, 715
price control 708, 721
sales 708, 710, 712, 713, 714, 715, 716
salient statistics 708
uses 709, 713, 714, 715, 716
Lime industry, annual review 708
labor shortage 709
technologic developments 723
Lime plants, size 711
Lime quarries, employment, data 86, 87
Lime quarry workers, injuries, data 86, 87
Limestone, crushed, sales 1125, 1126, 1127, 1129
fluxing, sales 1129
sales 1103, 1106, 1107, 1111, 1112
Limestone quarries, employment, data 86, 87
Limestone quarry workers, injuries, data 86, 87
Litharge, consumption 698
foreign trade 706
prices 691, 705
production 691
shipments 695
Lithium, allocation, WPB 1277
producers 1277
uses 1277
Lithium-aluminum hydride, use as reducer 1289
Lithium compounds, uses 1289
Lithium metal, price 1277
Lithium minerals, annual review 1289
shipments 1289
Lithium ores, prices 1290
Lithopone, consumption 701
foreign trade 162, 173, 706
prices 691, 705
production 691
sales 162, 172
shipments 696
Livingstonite, as source of mercury ore 781
Louisiana, minerals, production 28, 44
value 20, 44
natural gas, review 809, 811, 812, 813, 814, 817
natural gasoline, data 838, 840, 842, 844, 848
petroleum industry, review 878, 880, 882, 883, 884, 885, 891, 905, 907, 908, 909, 911, 912, 913, 914, 915, 917, 918, 919, 922, 923, 931, 939, 941, 945, 948, 950, 954, 958, 965, 968, 973, 975, 976, 977.
salt, data 1033, 1034
sulfur, data 1137
Louisiana Legislature, natural-gas shipments, restrictions, repeal of law 808
Lubican, as substitute for mica 792
Lubricating oil, annual review 973
demand 873, 973
foreign trade 925, 973
prices 974
production 924, 925, 927, 929, 930, 931, 932
salient statistics 925, 973
stocks 925, 928, 973
yields 927

M

Madagascar, gem-mining industry, revival, attempt 555
mica, data 783, 793, 795, 794, 796
radio-grade quartz, improved perforation 1295
uranium minerals, data 1227
Magnesia, caustic-calcined, foreign trade 737, 738
sales 737
refractory, foreign trade 737
sales 737
Magnesite, prices 739
price control 739
production 736, 737
salient statistics 737
Magnesite industry, annual review 736
Magnesium, prices 724, 726, 728
primary, consumption 724, 727
exports 724, 726, 727, 729
production 724, 725, 726, 727, 731
uses 727

Page

Magnesium—Continued
salient statistics 724
secondary, annual review 1072
consumption 1073
prices 1073
recovery 724, 725, 1065, 1072
stocks 1073
world review 731
Magnesium compounds, foreign 742
production trade 741, 742
sales 742
Magnesium compounds industry, annual review 736
Magnesium industry, annual review 724
technologic developments 730
Magnesium ingot, stock pile 725
Magnesium oxide, from olivine, Bureau of Mines method 738
Magnets, permanent, functions 391
Magnetite ore, production 601, 603, 605, 607
Maine, minerals, production 28, 45
value 20, 45
slate, data 1099
Malaya, bauxite, review 183, 184
columbite industry, data 1274
ilmenite, production 1189, 1191
Manchuria, molybdenum, data 803, 804
Manganese, electrolytic, review 760
metallurgical studies 753, 760
salient statistics 751
Manganese alloys, consumption 758
stocks 758
Manganese briquets, consumption 758
stocks 758
uses 504
Manganese industry, annual review 751
Manganese ore, consumption 751, 758, 759, 762, 764
deposits, investigations 753
ferruginous, consumption 763
shipments 754, 756
imports 751, 752, 757
metallurgical, shipments 754
prices 752, 764
price control 764
production 751, 752, 754, 765
shipments 751, 752, 754
stocks 758
stock pile 751, 753
value 752
world review 764
Manganiferous ore, consumption 759
salient statistics 754
Manhattan district, activities, report 1206
contracts for development of industrial atomic power 1221
Marble, crushed, sales 1125
foreign trade 1134
sales 1103, 1106, 1107, 1110
Marble quarries, employment, data 86, 87
Marble quarry workers, injuries, data 86, 87
"Marekanite," production 547
Maryland, bituminous-coal industry, data 272, 273, 285, 290, 295, 296, 297, 300, 305, 306, 309, 313 314, 317, 318, 319, 320, 331.
minerals, production 28, 46
value 20, 45
potash, byproduct, data 1025
slate, data 1099
Masonry cement, production 208, 228
shipments 208, 228
stocks 208, 228
Masonry mortars, production 226
Massachusetts, minerals, production 28, 46
value 20, 46
Mercurio Europeo, reestablishment, agencies 779
Mercury, consumption 767, 768, 775
foreign trade 767, 769, 777
price 768, 769
production 767, 768, 769
salient statistics 769
stocks 767, 776
stock pile 767, 776
uses 775
world review 779
Mercury cartel, reestablishment, agencies 779
Mercury cells, production, decrease 768
Mercury industry, annual review 767

Page

Mercury mines, principal, list 769
Mesothorium, uses 1277
Mesothorium salts, foreign trade 1278
Metals, fissionable, production 1209
minor, annual review 1266
Metal mills, employment, data 90
Metal-mill workers, injuries, data 90
Metal mines, employment, data 74, 75, 82, 83
Metal miners, injuries, data 75, 82, 83
Metals Reserve, Office of. *See* OMR.
Metallurgical plants, employment, data 74, 75, 89, 90
Metallurgical-plant workers, injuries, data 75, 90
Mexico, antimony, data 1569
arsenic, production 141, 142, 1569, 1570
bismuth, production 1569, 1570
cadmium, production 1569, 1570
cement, data 230, 231, 233
coal, data 344, 346, 1569, 1574
copper, production 1569, 1570
fluorspar, data 509, 522, 523, 524, 1569, 1573
gold, data 582, 585, 1569, 1570
graphite, exports 1569, 1574
iron ore, data 619, 622, 624, 1569, 1571
lead, review 682, 683, 684, 685, 688, 1569, 1572
Trade Agreement 668
manganese, data 1569, 1572
mercury, data 777, 778, 780, 781, 1569, 1573
mica, exports 1569, 1574
minerals, review 1568
molybdenum, data 802, 803, 804, 1569, 1573
petroleum, production 1569, 1575
pig iron, production 1569, 1571
salt, data 1042, 1043, 1045
silver, data 581, 584, 585, 1569, 1571
steel, production 1569, 1571
strontium, data 1569, 1574
sulfur, data 1142, 1143, 1145, 1559, 1574
tin, production 1569, 1573
tungsten, data 1569, 1573
uranium minerals, data 1227
vanadium, source 1573
zinc, production 1569, 1572
Mica, block, consumption 788
foreign trade 789
built-up, consumption 791
production 791
foreign trade 784, 792
ground, production 786
sales 786, 787
prices 791
punch, production 783, 784, 785
sales 784, 785, 788
salient statistics 784
scrap, imports 784, 793
production 785, 786
sales 784, 785, 786, 787, 788
sheet, consumption 788, 790
production 783, 784, 785
sales 784, 785, 788
substitutes 792
world review 794
Mica industry, annual review 783
Mica splittings, consumption 784, 790
foreign trade 789
stocks 790
Mica-splitting machine, development 783
Mica-tourmaline, deposit 555
Michigan, bituminous-coal industry, data 272, 273, 285, 290, 292, 295, 296, 297, 300, 305, 306, 314, 317, 318, 320, 323, 324, 331.
copper, production 1370, 1374, 1375
iron mining, costs 623
review 602, 603, 604, 605, 606, 607, 609, 610, 612, 613, 614, 617, 618, 621
iron ore, reserves 611
magnesium compounds, data 739
manganese ore, data 754, 755
minerals, production 28, 47
value 20, 47
natural gas, review 809, 811, 812, 813, 814, 817
nonferrous metals, production, annual review 1374
petroleum industry, review 878, 880, 882, 883, 884, 885, 893, 903, 905, 907, 909, 911, 912, 913, 914, 915, 917, 918, 919, 922, 923, 941, 950, 951, 958, 968.
potassium chloride, data 1025
silver, production 1369, 1375

Page

Middle America, mineral industry, annual review 1561, 1562
Millstones, sales 100
Minerals, consumption 4
prices 5
price control, removal 1
production 2, 3, 15, 30
radioactive, deposits on public lands, withdrawal from disposal 1212
statistical summary 12
stocks 5
strategic, list 7
value 2, 15, 19, 20, 30
Mineral-earth pigments, annual review 1290
foreign trade 1291, 1292
prices 1291
sales 1291
Mineral industries, annual review 1
employment data 6, 74
injury data 6, 74
Mineral wool, producers 1292
production 1292
standards 1293
uses 1292
Minnesota, iron mining, review 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 614, 617, 618, 621
iron ore, reserves 612
manganiferous ore, shipments 754, 755
minerals, production 28, 48
value 20, 48
Misch metal. *See* Cerium alloy.
Mississippi, minerals, production 28, 48
value 20, 48
natural gas, review 809, 811, 812, 813, 914, 818
petroleum industry, review 878, 880, 882, 883, 884, 885, 894, 905, 907, 909, 911, 912, 913, 914, 915, 917, 918, 919, 922, 939, 941, 950, 958, 968
Missouri, barite, data 161, 164
bituminous-coal industry, data 272, 273, 285, 290, 295, 296, 297, 300, 305, 306, 309, 313, 314, 320, 323, 324, 332.
cobalt, data 395
copper, production 1370
gallium, production 1275
iron ore, data 603, 604, 605, 606, 607, 614, 615, 617, 618, 621
lead, production 1370, 1377, 1378, 1380
limestone, sales 1104, 1108, 1112, 1113
minerals, production 28, 49
value 20, 49
natural gas, review 809, 811, 812, 813, 814, 818
nonferrous metals, production, annual review 1370
tripoli, sales 96
zinc, production 1370, 1377, 1378, 1379, 1380, 1382
Molding sand, sales 1047, 1049
Molybdenum, consumption 797, 800
deposits, exploration, Bureau of Mines 799
foreign trade 797, 802
prices 801
price control, removal 798, 801
salient statistics 797
shipments 797, 798
stocks 797, 801
uses 800
world review 803
Molybdenum concentrates, production 797, 798
Molybdenum industry, annual review 797
Government regulations 797
Molybdic oxide, uses 504
Monazite, as source material for atomic energy 1293
production 1226
stocks 1223
stock pile 1223
uses 1293
Monazite concentrates, production 1208
Monetary Fund, International, creation 560
Monsanto study, on costs of nuclear power 1218
Montana, Beaverhead County, metals, production 1455, 1458, 1559, 1460, 1461, 1462,
bituminous-coal industry, data 272, 273, 285, 290, 293, 295, 296, 297, 300, 305, 306, 309, 313, 314, 318, 320, 323, 324.
Broadwater County, metals, production 1455, 1458, 1459, 1460, 1461, 1462
Cascade County, metals, production 1455, 1458, 1459, 1460, 1461, 1462, 1465

Page

Montana—Continued
copper, production 1450, 1451, 1453, 1454, 1455, 1456, 1457, 1458, 1459, 1460, 1462.
Fergus County, metals, production 1455, 1458, 1459, 1460, 1461, 1462, 1465
Flathead County, metals, production 1460, 1462, 1465
gold, production 1450, 1451, 1452, 1453, 1455, 1456, 1457, 1458, 1459, 1460, 1462
Granite County, metals, production 1455, 1458, 1460, 1462, 1465
Jefferson County, metals, production 1455, 1458, 1459, 1460, 1462, 1468
Judith Basin County, metals, production 1455, 1460, 1462, 1467
lead, production 1450, 1451, 1453, 1454, 1455, 1456, 1457, 1458, 1459, 1460, 1462
Lewis and Clark County, metals, production 1455, 1458, 1459, 1460, 1463, 1467
lignite industry, data 272, 273, 285, 290, 293, 295, 296, 297, 300, 305, 309, 314, 318, 320, 333, 340, 341
Lincoln County, metals, production 455, 1458, 1459, 1463, 1468
Madison County, metals, production 1455, 1458, 1459, 1460, 1463, 1468
manganese ore, shipments 754, 755
Meagher County, metals, production 1455, 1460, 1463, 1469
metallurgic industry, review 1457
minerals, production 28, 50
value 20, 50
Mineral County, metals, production 1455, 1458, 1459, 1463, 1469
mining industry, review 1456
Missoula County, metals, production 1455, 1460, 1463, 1469
moss agate, deposits, partial exhaustion 546
natural gas, review 809, 811, 812, 813, 814, 818
nonferrous metals, production, annual review 1450
ore, classification 1456
Park County, metals, production 1455, 1458, 1459, 1460, 1463, 1469
petroleum industry, review 878, 880, 882, 883, 884, 894, 905, 907, 909, 913, 914, 915, 917, 918, 919, 922, 941, 949, 958, 968.
Phillips County, metals, production 1455, 1460, 1464, 1470
phosphate rock, review 989, 990, 997, 998, 999
placer mines, production 1451, 1452
Powell County, metals, production 1455, 1458, 1459, 1460, 1464, 1470
pyrites, recovery 1146
Ravalli County, metals, production 1455, 1458, 1459, 1464, 1470
Sanders County, metals, production 1455, 1458, 1459, 1460, 1464, 1471
silver, production 1450, 1451, 1453, 1455, 1456, 1457, 1458, 1459, 1460, 1462
Silver Bow County, metals, production 1458, 1459, 1460, 1464, 1471
tungsten, data 1194, 1195, 1197
vanadium, recovery from phosphate rock 1235
zinc, production 1450, 1451, 1453, 1454, 1455, 1456, 1457, 1458, 1459, 1460, 1462
Moss agate, deposits 546
Motor fuel, annual review 936
consumption 941
demand 872, 873, 874, 875, 876, 925, 936, 937, 938
distribution 942
foreign trade 925, 936, 937, 938, 947
prices 933, 946
production 872, 924, 925, 926, 927, 929, 930, 931, 932, 936, 937, 938, 939, 940, 941
salient statistics 925, 937, 938
shipments 943
stocks 925, 928, 936, 937, 938, 943
yields 927
See also Aviation gasoline.
Muscovite, status as strategic mineral 783
Mycalex products, manufacture, improvement 787

N

Naphtha, production 846
solvent, production 448
supply 846
Naphthalene, production 448
Natural gas, as source of carbon black 830
competitive fuels 266, 275, 276, 278, 279
consumption 805, 807, 812, 813, 828
disposition 811
exports 805, 807
loss and waste 811
price 805, 808
production 805, 807, 810, 811, 812
marketed 807, 812
reserves, American Gas Association studies 808
salient statistics 807
shipments 823
storage, underground 834
treated for natural gasoline 829
use, at refineries 848
with manufactured gas 833
value 805, 807
Natural-gas industry, annual review 805
Government regulations 808
outlook 806
technologic developments 833
Natural-gas liquids, in recoverable gas reserves, estimate 809
reserves, American Gas Association studies 838
Natural-gas meters, number 806
Natural-gas pipe lines, construction, approval 808
developments 827
large-diameter, movement of gas in 834
war, lease by WAA 808
Natural-gas wells, number 807, 812
Natural gasoline, demand 835, 845
distribution 846
foreign trade 836, 855
prices 835, 836, 854
production 835, 836, 837, 839, 840, 844
by processes 843, 844
cycle plants 843
sales 836, 849
salient statistics 836, 872
shipments 836, 837, 845
stocks 835, 836, 853, 854, 872, 873, 874, 916
supply 846, 873, 874, 876
value 835, 836
yields 844
Natural-gasoline industry, annual review 835
outlook 836
Natural-gasoline plants, number 845
Nebraska, minerals, production 28, 51
value 20, 51
petroleum industry, review 880, 882, 883, 895, 905, 907, 909, 913, 914, 919, 922, 941, 949, 958, 968.
Nepheline syenite, composition 497
deposits 497
imports 490
prices 498
review 497
uses 497
Nephrite, occurrence 545
Netherlands, barite, tariff reduction, request 163
Netherlands East Indies, bauxite, data 183, 185
monazite, production 1230
tin, review 1159, 1160, 1161, 1169, 1170, 1173, 1174, 1179
Netherlands Guiana. *See* Surinam.
Netherlands West Indies, gold, production 1568
minerals, review 1568
petroleum, imports for refining 1568
phosphate, production 1568
salt, shipment 1568
Nevada, antimony, data 130
barite, deposits 163
Churchill County, metals, production 478, 1481, 1483, 1484, 1485
Clark County, metals, production 1478, 1481, 1482, 1483, 1484, 1485
copper, production 1474, 1475, 1476, 1477, 1478, 1479, 1480, 1481, 1482, 1483, 1485
Elko County, metals, production 1478, 1481, 1482, 1483, 1485, 1488
Esmeralda County, metals, production 1478, 1481, 1482, 1483, 1485, 1488
Eureka County, metals, production 1478, 1481, 1482, 1485, 1489
fluorspar, data 509, 510, 512, 519
gold, production 1473, 1474, 1475, 1477, 1478, 1479, 1480, 1481, 1482, 1483, 1485

Nevada—Continued Page
gold mines, leading, list 1476
Humboldt County, metals, production 1478, 1481, 1483, 1485, 1489
Lander County, metals, production 1478, 1481, 1482, 1483, 1485, 1489
lead, production 1473, 1474, 1475, 1477, 1478, 1479, 1480, 1481, 1482, 1483, 1485
Lincoln County, metals, production 1478, 1481, 1482, 1483, 1486, 1490
Lyon County, metals, production 1478, 1481, 1483, 1486, 1491
magnesium compounds, data 740
magnetite, data 603, 604, 605, 606, 607, 614, 615, 618, 621
manganese ore, shipments 754, 755
mercury, production 769, 770, 773
metallurgic industry, review 1480
minerals, production 28, 51
value 20, 51
Mineral County, metals, production 1478, 1481, 1482, 1483, 1486, 1491
mining industry, review 1479
molybdenum, data 799
nonferrous metals, production, annual review 1473
Nye County, metals, production 1478, 1481, 1482, 1483, 1486, 1492
ore, classification 1479
Pershing County, metals, production 1478, 1481, 1482, 1483, 1486, 1492
salt, data 1034
silver, production 473, 1474, 1475, 1477, 1478, 1479, 1480, 1481, 1482, 1483, 1485
silver mines, leading, list 1476
Storey County, metals, production 1478, 1481, 1482, 1483, 1486, 1493
sulfur, data 1137
tungsten, review 1194, 1195, 1197
turquoise, production 547
Washoe County, metals, production 1478, 1481, 1482, 1483, 1487, 1493
White Pine County, metals, production 1478, 1481, 1482, 1483, 1487, 1493
zinc, production 1473, 1474, 1475, 1477, 1478, 1479, 1480, 1481, 1482, 1483, 1485
New Caledonia, nickel, data 858, 859, 860, 861
Newfoundland, fluorspar, data 509, 522, 523, 524
iron ore, data 619, 622, 624
lead, data 683, 688
zinc, data 1261, 1265
New Hampshire, minerals, production 28, 52
value 20, 52
New Jersey, magnesium compounds, data 740
magnetite, data 603, 604, 605, 606, 607, 614, 616, 617, 618, 621
minerals, production 28, 53
value 20, 53
nonferrous metals, production, annual review 1419
titanium pigments, new plant 1184
zinc, production 1417, 1419
New Mexico, bituminous-coal industry, data 272, 273, 285, 290, 293, 295, 296, 297, 300, 305, 306, 309, 313, 314, 318, 319, 320, 323, 324, 333.
Catron County, metals, production 1500, 1504, 1505
copper, production 1495, 1496, 1497, 1498, 1500, 1501, 1502, 1503, 1504, 1505
Dona Ana County, metals, production 1500, 1503, 1504, 1505
fluorspar, review 507, 509, 510, 512, 519
gold, production 1496, 1497, 1500, 1501, 1502, 1503, 1504, 1505
Grant County, metals, production 1500, 1503, 1504, 1505, 1506
Hidalgo County, metals, production 1500, 1503, 1504, 1505, 1508
lead, production 1495, 1496, 1497, 1499, 1500, 1501, 1502, 1503, 1504, 1505.
manganese ore, shipments 754, 755
metallurgic industry, review 1501
minerals, production 28, 54
value 20, 54
mining industry, review 1501
molybdite, data 799
natural gas, review 809, 811, 812, 813, 814, 818
nonferrous metals, production, annual review 1495

New Mexico—Continued Page
ore, classification 1501
pegmatites, as source of gem stones 547
petroleum industry, review 875, 880, 882, 883, 884, 885, 896, 905, 907, 909, 913, 914, 915, 917, 918, 919, 920, 922, 923, 941, 949, 958, 968.
potash salts, review 1025
Santa Fe County, metals, production 1500, 1502, 1503, 1504, 1508
silver, production 1495, 1496, 1497, 1498, 1500, 1501, 1502, 1503, 1504, 1505
Socorro County, metals, production 1500, 1502, 1503, 1504, 1505, 1508
turquoise, production 547
zinc, production 1495, 1496, 1497, 1499, 1500, 1501, 1502, 1503, 1504, 1505
New York, garnets, deposits 548
Gouverneur talc district, map 1151
ilmenite, production 1183, 1184
lead, production 1417, 1419
magnetite, data 603, 604, 605, 606, 607, 609, 614, 616, 617, 618, 621
minerals, production 28, 55
value 20, 55
natural gas, review 809, 811, 812, 813, 814, 819
nonferros metals, production, annual review 1419
petroleum industry, review 878, 880, 882, 883, 884, 896, 905, 907, 909, 913, 914, 915, 917, 918, 919, 920, 922, 941, 950, 951, 958, 968.
pyrites, shipments 1146
silver, production 1416, 1419
slate, review 1098, 1099
zinc, production 1417, 1419
New Zealand, gem stones, deposits 555
radioactive minerals, search 1230
Nicaragua, gold, data 582, 586, 1579
minerals, review 1579
petroleum, exploration 1579
salt, production 1579
silver, exports 1579
Nickel, consumption 857
decline, labor strikes as cause 856
foreign trade 856, 858
prices 856
primary, production 856, 857
salient statistics 856
secondary, annual review 1079
consumption 1080
exports 1080
Government regulations 1080
prices 1080
recovery 1065, 1079
stocks 1080, 1081
stocks 857
uses 856, 857
world review 859
Nickel industry, annual review 856
Nickel products, foreign trade 859
Nigeria, columbite, production 1274
tantalite industry, stimulation 1274
tin, review 1169, 1173, 1180
Nitrate, deposits, domestic 863
natural, review 863
Nitrogen, demand, decrease 862
Nitrogen compounds, annual review 862
as source of fertilizers 862
foreign trade 863
inorganic, annual review 863
salient statistics 862
synthetic, review 864
Nonmetals, minor, annual review 1285
Nonmetal mines, employment, data 74, 75, 85
Nonmetal miners, injuries, data 75, 85
North America. *See* Bahamas; Barbados; Bermuda; British Honduras; British West Indies; Caicos Island; Canada; Central America; Costa Rica; Cuba; Dominican Republic; Greenland; Guatemala; Haiti; Honduras; Jamaica; Mexico; Middle America; Netherlands West Indies; Newfoundland; Nicaragua; Nova Scotia; Panama; Salvador; El Trinidad; Turks Island; United States; West Indies.
North Carolina, asbestos, data 144
ilmenite, production 1184
minerals, production 28, 56
value 20, 56
tungsten, data 1194, 1195, 1198

Page

North Dakota, lignite industry, data 272, 273, 285, 290, 293, 295, 296, 297, 300, 305, 306, 309, 313, 314, 318, 319, 320, 323, 324, 333, 340, 341.
minerals, production 28, 57
value 20, 57
natural gas, review 809, 811, 812, 813, 814, 819
Norway, aluminum, data 122, 126
ilmenite, production 1187, 1189, 1191
iron ore, data 622, 625
molybdenum, data 803, 804
nickel, data 858, 860, 861
pyrites, data 1147, 1148, 1149
uranium minerals, data 1229
Nova Scotia, slate industry, organization 1101
Nuclear power, California scientists' study 1219
possible commercial use, Westinghouse study 1219
possible cost and uses, Monsanto study 1218
Nuclear power stations, estimated costs, compared with coal-fuel power stations 1220
Nucleonics, information on control 1205

O

Obsidian, production 547
Oceania. *See* Australia; New Caledonia; New Zealand.
Ocher, foreign trade 1291, 1292
OEM, agencies included 8
Ohio, bituminous-coal industry, data 272, 273, 285, 290, 292, 295, 296, 297, 300, 305, 306, 309, 313, 314, 317, 318, 319, 320, 323, 324, 333.
minerals, production 28, 58
value 20, 58
natural gas, review 809, 811, 812, 813, 814, 819
petroleum industry, review 878, 880, 882, 883, 897, 905, 907, 909, 911, 912, 913, 914, 915, 917, 918, 919, 920, 922, 941, 950, 951, 958, 968.
salt, data 1033, 1034
Oil, as source of energy 275, 276, 277, 278, 279
competitive fuels 266, 275, 276, 277, 279
drying, supply problems 693
Oil and Gas Division, organization 10
Oilstones, foreign trade 109
sales 99
Oil wells, completions 872, 904
number drilled 904, 905, 906
producing, number 872, 905, 907
Oklahoma, bituminous-coal industry, data 272, 273, 285, 290, 295, 296, 297, 300, 305, 306, 310, 313, 314, 318, 319, 320, 324, 334.
lead, production 1370, 1383
minerals, production 28, 59
values 20, 59
natural gas, review 809, 811, 812, 813, 814, 820
natural gasoline, data 838, 840, 842, 844, 848
nonferrous metals, production, annual review 1383
petroleum industry, review 878, 880, 882, 883, 884, 885, 897, 905, 907, 908, 909, 911, 912, 913, 914, 915, 917, 918, 919, 920, 922, 923, 931, 939, 941, 945, 948, 950, 954, 958, 965, 968, 973, 975, 976, 977.
zinc, production 1370, 1383
Oklahoma Corporation Commission, price fixing, natural gas 808
Olivine, magnesium oxide from, Bureau of Mines method 738
marketing 555
sales 1294
shipments 1293
sources 1293
OMR, price control, tin 1167, 1168
stock pile, bauxite 174, 180
bismuth 188
chromite 238, 241
columbite 1273
copper 458, 472
lead, reduction 1083
magnesium ingot 725
manganese ore 753
mercury 767, 776
release, platinum 1006
tantalite 1273
Onyx, foreign trade 1134
OPA, organization 9
price control, aluminum 118
ammonium sulfate 447

Page

OPA, price control—Continued
antimony 132
secondary 1089
arsenic 139
brass ingot 1078
bronze ingot 1078
cement 209
coke 407
copper, secondary 1077
ferrous scrap 645
fluorspar 514
fuel oil 962
lead, secondary 1084
lime 708, 721
nitrates 863
phosphate rock 992
removal 1
barite 169
cadmium 191
carbon black 205
chromite 238, 243
cobalt 392
copper 461
greensand 1287
iodine 745
kyanite minerals 1288
lead 666
magnesite 739
manganese ore 764
molybdenum 798, 801
pigments 692
platinum metals 1009
pyrophyllite 1154
silver 559
soapstone, ground 1154
talc 1154
tin 1161
vermiculite 1297
sodium nitrate, synthetic 865
tar 407
zinc 1257
secondary 1092
Opal, deposits, discovery 554
Orange mineral, consumption 698
foreign trade 706
shipments 695
Ore-dressing plants, employment, data 89, 90
Ore-dressing-plant workers, injuries, data 90
Oregon, agate, deposits 546
antimony, data 130
Baker County, metals, production 1513, 1514, 1515, 1517
bituminous-coal industry, data 272, 290, 296, 297, 300, 305, 306, 314, 318, 319, 320, 323, 324, 335.
chromite, production 239
copper, production 1509, 1510, 1513, 1514, 1515, 1516, 1517
Curry County, metals, production 1513, 1515, 1517
gold, production 1509, 1510, 1511, 1512, 1513, 1514, 1515, 1516, 1517
Grant County, metals, production 1513, 1515, 1517
Harney County, metals, production 1513, 1515, 1517, 1518
Jackson County, metals, production 1513, 1515, 1517, 1518
Jefferson County, metals, production 1513, 1515, 1517, 1519
Josephine County, metals, production 1513, 1515, 1517, 1519
Lane County, metals, production 1513, 1515, 1517, 1519
lead, production 1509, 1510, 1513, 1514, 1515, 1516
Malheur County, metals, production 1513, 1519
mercury, review 769, 770, 774
metallurgic industry, review 1514
minerals, production 28, 60
value 20, 60
mining industry, review 1513
nonferrous metals, production, annual review 1509
ore, classification 1514
placer mines, production 1510, 1511, 1513, 1517
silver, production 1509, 1510, 1512, 1513, 1514, 1515, 1516, 1517
Union County, metals, production 1515, 1519
Wheeler County, metals, production 1513, 1515, 1517, 1519

Page

Osmiridium, price 1009
Osmium, price 1006, 1009
recovery 1008, 0091
OTC controls, chromite 238
establishment 8
Oven coke. *See* Coke, oven.

P

Packaged fuel, binders 543
description 537
processes used 541
production 525, 538, 539, 540, 541
raw fuels 542
salient statistics 538
value 538, 539
Packaged-fuel industry, annual review 525, 537
outlook 537
Packaged-fuel plants, capacity 541
classification 542, 543
number 525, 538, 539, 540
Paint industry, outlook 693
Palladium, consumption 1010
production 1006, 1008
recovery 1008, 1009
refined, production 1007, 1008
sales 1007, 1010
secondary, recovery 1006, 1009
stocks 1006, 1012
Panama, manganese ore, data 766, 1579
minerals, review 1579
petroleum, exploration 1579
salt, production 1579
Paraguay, petroleum, production 1596
Paris green, price 139
Pattinson process, for recovery of magnesium compounds 739, 740
Paving gravel, sales 1047, 1052
Paving sand, sales 1047, 1050
PAW, organization 10
Peat, annual review 866
Government specifications 867
price 867
production 866, 867
reserves 866
uses 867
Peat moss, imports 868
Pegmatites, as source of gem stones 547
Pennsylvania, anthracite, production 295, 349, 350, 351, 356, 357, 359, 360, 364, 365, 366
See also Anthracite.
anthracite industry, review 349
bituminous-coal industry, data 272, 273, 285, 291, 292, 295, 296, 297, 300, 305, 306, 310, 313, 314, 318, 319, 320, 323, 324, 335.
cobalt, in iron ore 394
coke, production 416
copper, production 1420
gold, production 1415, 1416, 1420
magnesium compounds, data 740
magnetite, data 603, 604, 605, 606, 607, 608, 609, 614, 616, 617, 618, 621
minerals, production 28, 61
value 20, 61
natural gas, review 809, 811, 812, 813, 814, 820
nonferrous metals, production, annual review 1320
petroleum industry, review 878, 880, 882, 883, 884, 885, 899, 905, 907, 909, 911, 912, 913, 914, 915, 917, 918, 919, 920, 922, 923, 931, 941, 950, 951, 958, 968.
pyrites, production 1146
rottenstone, production 96
silver, production 1415, 1416, 1420
slate, review 1098, 1099, 1100
Pennsylvania State College, anthracite research 355
Periclase, foreign trade 738
Perlite, prices 1294
producers, list 1294
Persian Gulf, petroleum, imports 871
Peru, antimony, production 1597, 1598
bismuth, data 187, 188, 190
coal, production 1597, 1600
copper, production 1597, 1598
gold, production 1597, 1598
lead, review 682, 683, 685, 689, 1597, 1599
mercury, production 1597, 1599

Page

Peru—Continued
metals, byproduct, production 1597, 1598
minerals, exports 1597
production 1597
review 1596
molybdenum, data 802, 803, 804
nonmetals, data 1600
petroleum, production 1597, 1600
silver, data 584, 586, 1597, 1599
steel industry, prospective 1598
tatronite, discovery 1239
tungsten concentrates, data 1597, 1599
vanadium, data 1597, 1599
zinc, production 1597, 1599
Petroleum, consumption 870, 907
demand 870, 871, 873, 876, 879, 909, 911, 913
distribution 907, 915
foreign trade 871, 872, 876, 879, 978
prices 872, 921, 922, 923
production 870, 872, 873, 874, 876, 879, 880, 881, 882, 883, 884, 986
receipts at refineries 910
reserves 877, 878
run to stills 872, 875, 907, 908, 924
salient statistics 872
shipments, intercoastal 977
stocks 872, 873, 916, 917, 918, 919
supply 870, 871, 873, 876, 877, 879
world 877
value 921, 922
world review 986
Petroleum Administration for War. *See* PAW.
Petroleum asphalt, consumption 153, 156
data 976
demand 152
distribution 157
foreign trade 152, 153, 158, 159, 925, 976
production 152, 153, 924, 925
sales 153, 154, 155
salient statistics 925
stocks 153, 925
yields 927
Petroleum-asphalt industry, annual review 152
Petroleum coke, annual review 975
foreign trade 925, 975
production 924, 925, 975, 976
salient statistics 925
stocks 925, 976
yields 927
Petroleum fields, leading, production 884
Petroleum gases, liquefied, exports 855
prices 854
production 835, 836, 839, 840, 842, 844
sales 836, 849, 850
stocks 854
Petroleum industry, annual review 870
Petroleum products, annual review 923
production 924, 925
run to stills 924
salient statistics 872, 925
stocks 873, 916
yields 926, 927
Petroleum refineries, capacity 934
Petroleum wells, completions 872, 904
number drilled 904, 905, 906
producing, number 872, 905, 907
Phlogopite, status as strategic mineral 783
Phosphate rock, consumption 989, 991
demand 988
foreign trade 988, 989, 1000
price control 992
production 988, 989, 990
sales 988, 989, 990
salient statistics 989
technologic reports, list 1003
uses 991
world review 1004
Phosphate-rock industry, annual review 988
Phosphorus-32, use in treating polycythemia 1222
Piersol process, for briquetting coal, tests 536
Pig iron, consumption 635, 636, 643, 646, 649, 650
foreign trade 627, 638, 639
manganiferous, consumption 763
in manufacture of pig iron 632
ore 632
manufacture, coke consumed 434
Premium Payment Plan 628
prices 637, 638, 643

Page

Pig iron—Continued
production 401, 627, 628, 629, 644
raw materials, metalliferous 631, 632
salient statistics 627, 643
shipments 627, 629
silvery, consumption 503
stocks 643, 1167
Pig iron industry, annual review 626
wartime control, amendment 628
Pig lead. *See* Lead, primary, production.
Pigments, demand 690
price control, removal 692
shipments 690
uses 691
See also Lead pigments; Zinc pigments.
Pigments industries, reduced production caused by labor strikes 690
Platinum, consumption 1007, 1010
crude, production 1006, 1008, 1009
source 1008
prices 1006, 1009
recovery 1008, 1009
refined, production 1006, 1008
sales 1010
stocks 1006, 1012
stock pile, release 1006
world review 1015
Platinum industry, annual review 1006
Platinum metals, annual review 1006
foreign trade 1006, 1012
price control, removal 1009
secondary, recovery 1006, 1009
world review 1015
Plume agate, production 546
Plutonium, competitive costs with coal 1220
prices 1223
production 1211
reserves 1212
uses 1210
Plutonium plants, location 1211
Polishing sand, sales 1047, 1050
Portland cement, consumption 208, 209, 214
mill values 219
price 207, 208, 219
production 208, 210, 211, 212
fuel consumed 224, 225
power consumed 224, 226
raw materials 222, 224
salient statistics 208
shipments 207, 208, 210, 211, 212, 214, 216, 218
stocks 208, 210, 211, 212, 214
supplies 218
types 226
Portland-cement clinker, production 221, 222
stocks 222, 223
Portland-cement industry, annual review 207
Portland-cement plants, capacity 220, 221
distribution 221
Portugal, pyrites, data 1148, 1149
uranium minerals, data 1229
Potash, exploration on public domain, cessation 1018
prospecting for, Land Management regulations, amendment 1018
salient statistics 1018
Potash fertilizers, foreign trade 1017
Potash industry, annual review 1017
OPA controls 1018
Potash producers, list 1021
Potash residues, as source of potassium perrhenate 1279
Potash salts, consumption 1017
deliveries 1023
foreign trade 1018, 1026
prices 1024
production 1017, 1018, 1019, 1020, 1021
sales 1017, 1018, 1019, 1021, 1022
stocks 1019, 1021
world review 1030
Premium Payment Plan, pig iron 628
Premium Price Plan, bonuses, copper 473
lead 668, 679, 680
zinc 1242, 1257, 1258
Price Administration, Office of. *See* OPA.
Price control. *See* OPA.
Propane, nonfuel uses 852
production 846, 847

Page

Propane—Continued
sales 850, 852
supply 846
Puddling furnaces, consumption of ferrous scrap and pig iron 656
Pulpstones, production 93
sales 99, 100
Pumice, foreign trade 92, 109, 110
prices 102
review 101
sales 93, 101, 102
uses 102, 103
Pumicite, review 101
sales 93, 101, 102
uses 103
Puzzolan cement, production 208, 228
shipments 208, 228
stocks 208, 228
Pyridine, production 448
Pyridine bases, recovery, method 443
Pyrites, foreign trade 1136, 1146
prices 1136, 1146
production 1136, 1145
salient statictics 1136
world review 1147
Pyrites industry, annual review 1135
production of byproduct iron ore 602
Pyrophyllite, consumption 1153
prices 1154
sales 1150, 1151, 1152
price control 1154
salient statistics 1151
uses 1153
world review 1156
Pyrophyllite industry, annual review 1150

Q

Quarries, employment, data 74, 75, 85, 86
Quarry workers, injuries, data 75, 85, 86
Quartz, prices 98
production 93
radio-grade, foreign sources 1295
imports 1295
military demands 1295
prices 1296
review 97
sales 97, 98
Quartzite, foreign trade 1134
uses, new 101
Quicklime, prices 708
sales 708, 710, 712, 714, 715

R

Radiocarbon, source 1222
Radioiodine, medical value 1222
Radioisotopes, availability, restriction 1221
definition 1221
deliveries to private institutions 1206
derivation 1221
Radiophosphorus, medical uses 1222
Radium, source 1277
uses 1277
Radium salts, foreign trade 1278
Railroad ballast, sales 1047, 1051, 1053, 1118, 1119
Range oil, annual review 947
sales 949, 951
Reconstruction and Development, International Bank for, creation 560
Reconstruction Finance Corporation. *See* RFC.
Red lead, consumption 697
foreign trade 706
prices 691, 705
production 691
shipments 695
Reduction plants, employment, data 90, 91
Reduction-plant workers, injuries, data 91
Refineries, employment, data 90, 91
Refinery workers, injuries, data 91
Refractories, production 260, 261, 262
shipments 261, 262
stocks 260, 262
Retort coke, salient statistics 409
RFC, authority to purchase tin ores and concentrates 1161
organization 11

Page

Rhenium, characteristics 1279
prices 1279
production, domestic 1279
Rhode Island, minerals, production 28, 62
value 20, 62
Rhodesia, Northern, cobalt, data 398, 399
copper, review 476, 480, 481, 487
vanadium oxide, production 1238
Southern, asbestos, review 148, 149, 150
chromite, review 241, 243, 244, 245, 246
Rhodium, price 1009
recovery 1008
Rhodochrosite, shipments 755
Road metal, sales 1118
Road oil, data 976
production 160, 924, 926
review 160
sales 160
salient statistics 926
stocks 926
yields 927
Rochelle salts, use as substitute for radio-grade quartz 1295
Rock salt, production 1034
sales 1031, 1032
Roman cement, foreign trade 229
Roofing slate, foreign, qualties 1101
prices 1098
Roofing granules, annual review 1120
sales 1120
Roofing slate, sales 1094, 1096, 1097, 1099, 1100
Rottenstone, foreign trade 109
prices 97
producers 97
production 96
sales 96
Ruby, source 553
Rumania, molybdenum-bismuth deposits 804
Ruthenium, price 1006, 1009
recovery 1008
Rutile, consumption 1185
foreign trade 1187
prices 1184, 1186, 1187
production 1183, 1184
shipments 1184
stocks 1186
world review 1189

S

Salines, miscellaneous, annual review 743
Salt, distribution 1035, 1036
evaporated, production 1031, 1034
sales 1031, 1032
foreign trade 1031, 1040
marketing 1035
prices 1031, 1039
production 1031, 1032, 1033, 1034
salient statistics 1031
uses 1037
world review 1042
Salt blocks, sales 1032, 1034, 1035
Salt cake, foreign trade 748
production 747
Salt industry, annual review 1031
Salt mines, labor strikes, decreased production 1031
Salvador, El, gold, production 1576
lead-zinc ores, exploration 1576
minerals, review 1576
nonmetals, data 1576
silver, production 1576
Sands, abrasive, sales 99
consumption, trends 1057
foreign trade 1061
ground, production 93
review 98
sales 98, 99
industrial, production 1058
preparation 1055
prices 1060
production 1046, 1048, 1058, 1059
sales 1046, 1047, 1048, 1049, 1054, 1055, 1057
transportation 1056
Sand industry, annual review 1026
labor data 1058
technologic developments 1061
Sand plants, size 1056

Page

Sandstone, crushed, sales 1129, 1130
ground, review 98
sales 98, 99
sales 1103, 1106, 1107, 1113, 1114
Sandstone quarries, employment, data 86, 88
Sandstone quarry workers, injuries, data 86, 88
Sapphire, source 553
Scrap, ferrous, consumption 642, 643, 644, 646, 649, 650
CPA distribution 645
foreign trade 643
prices 643
salient statistics 643
stocks 643
See also Iron scrap; Steel scrap.
Secondary metals, definition 1067
ferrous, annual review 642
nonferrous, annual review 1065
recovery 1066
value 1066
salient statistics 1065
Selenium, foreign trade 1281
prices 1281
producers, list 1280
production, decrease 1280
salient statistics 1280
uses 1280
SFAW, coke industry, regulation 407
organization 10
Shale, sales 257
Ship-breaking program, to provide steel scrap 644
Siam, gem resources, need of development 554
tin industry, review 1159, 1170, 1173, 1174, 1180
Sienna, foreign trade 1291, 1292
Silica, amorphous, producers 97
production 96
Silica abrasives, natural, production 92, 93, 94
Silica-stone products, review 99
Silicate abrasives, natural, review 101
Silicomanganese, consumption 758
stocks 758
uses 504
Silicon carbide, producers 107
production 93, 107
stocks 108
Sillimanite schist, investigations 1288
Silver, buying price, Treasury 558
consumption, industrial 577
foreign trade 558, 559, 579, 580
from base-metal ores, output, reduction, due to labor strike 557
prices 559, 578
price control 559
production, cumulative table 576
mill 574
mine 557, 559, 561, 562, 564, 568, 571, 572, 581, 584
refinery 575
sale, under Green Act 559
salient statistics 559
stocks, monetary 559, 578
world review 580
Silver industry, annual review 557
Silver mills, employment, data 90
Silver-mill workers, injuries, data 90
Silver mines, employment, data 83, 84
leading list 566
Silver miners, injuries, data 83, 84
Silver ore, production 569
Silver Purchase Act, amendment 559
Sinter, consumption 609
production 609
Slag, basic, annual data 1005
Slag-fuming plants, for recovering zinc from lead slags, list 1249
Slate, dimension, sales 1094, 1095, 1096, 1097, 1099, 1100, 1106
foreign trade 1101
prices 1098
sales 1094, 1095, 1096, 1097, 1099, 1100
salient statistics 1094
value 1094, 1096, 1097, 1098, 1099, 1100
world review 1101
Slate flour, sales 1094, 1096, 1097
Slate granules, sales 1094, 1096, 1097
uses 1095, 1097
Slate industry, annual review 1094
Slate quarries, employment, data 86, 88
Slate quarry workers, injuries, data 86, 88

Page

Slip clay, consumption 248
sales 248, 257
Smelters, employment, data 90, 91
Smelter workers, injuries, data 91
Smyth report, on activities of Manhattan district 1206
Soapstone, ground, annual review 1150
consumption 1153
foreign trade 1155
price control 1154
sales 1150, 1151, 1152, 1153
salient statistics 1151
uses 1153
world review 1156
Soda ash, prices 746
production, proposed expansion 746
Sodium carbonate, consumption 748
producers, list 746
production 746
sales 747
Sodium compounds, annual review 746
Sodium metal, price 749
producers 748
uses 748
Sodium-metal industry, German, information 749
Sodium nitrate, imports 863, 864
price control 863
synthetic, price control 865
source 865
Sodium phenolate, production 448
Sodium-potassium nitrate, imports 864
Sodium sulfate, foreign trade 748
producers, list 747
production 747
sales 747
Solid Fuels Administration for War. *See* SFAW.
South America, mineral industry, annual review 1561, 1580
See also Argentina; Bolivia; Brazil; British Guiana; Chile; Colombia; Ecuador; French Guiana; Paraguay; Peru; Surinam; Uruguay; Venezuela.
South Carolina, manganese ore, shipments 754, 756, 757
minerals, production 28, 62
value 20, 62
South Dakota, gold, production 1520, 1521, 1522
Homestake mine, production 1520, 1522
lignite industry, data 272, 273, 291, 293, 295, 296, 297, 300, 305, 310, 313, 314, 320, 335, 340, 341
metallurgic industry, review 1522
minerals, production 28, 63
value 20, 63
natural gas, review 809, 811, 812, 813, 814, 820
nonferrous metals, production, annual review 1520
Lawrence County, metals, production 1521, 1522
mining industry, review 1522
Pennington County, production 1521, 1524
silver, production 1520, 1521, 1522
South-West Africa, as source of gem stones 555
vanadium, data 1239
Spain, bismuth, data 190
cement, data 232, 235
lead, data 685, 689
pyrites, data 1146, 1147, 1148, 1149
uranium deposits, reservation 1229
Spanish Morocco, antimony, data 135, 136
Spiegeleisen, consumption 758
foreign trade 751, 761, 763
price 502
production 502, 751, 761, 763
shipments 502
stocks 758
Spodumene, deposits 555
prices 1290
Steatite, foreign trade 1155, 1156
Steel, alloy, production 634
basic open-hearth, production 513
consumption 626
foreign trade 627, 639, 640
prices, increase 629
production 627, 632, 633
effect of strikes 626
salient statistics 627
supplies, scarcity 626
Steel casing, manufacture 633
Steel furnaces, metalliferous, raw materials 634

Page

Steel industry, annual review 626
strikes, effect on production 624, 643
wages, increase 629
Steel ingots, manufacture 633
Steel scrap, consumption in ferro-alloys 658
CPA distribution 645
price controls 645
supply, increase, by ship-breaking program 644
world review 664
Steel-scrap industry, annual review 642
Government regulations 645
Still gas, data 976
production 924, 976
yields 927
Stock pile, Government, activities 6
aluminum 112, 113, 118
amosite 144
antimony 128
arsenic 139
asbestos 144
bauxite 180
bismuth 188
cadmium 191
chromite 238, 241
copper 458, 472
diamond, industrial 552
graphite 1286
lead 666
magnesium ingot 725
manganese ore 751, 753
mercury 767, 776
monazite 1223
zinc 1242
Stone, broken. *See* Stone, crushed.
Stone, crushed, annual review 1117
markets 1132
plants, size 1121
production 1102
sales 1103, 1117, 1118
technologic developments 1133
transportation 1121, 1122
dimension. *See* Dimension stone.
miscellaneous, crushed, sales 1129, 1131
sales 1103, 1106, 1115
Stone industry, annual review 1102
technologic developments 1117
Stoneware clay, annual review 252
consumption 248
foreign trade 247
sales 247, 248, 253
uses 248
Strategic and Critical Materials Stock-Piling Act 1
Strontium chemicals, annual review 1296
exports 1297
Sulfur, consumption 1139
prices 1136, 1139
production 1136, 1137, 1138
recovery as byproduct 1138
salient statistics 1136
shipments 1136, 1137
stocks 1136, 1139
uses 1140
world review 1143
Sulfur industry, annual review 1135, 1137
Sulfuric acid, byproduct, recovery 1138, 1252
consumption 1140
foreign trade 1136, 1141
Superphosphates, exports 1003
Surinam, bauxite, review 174, 181, 183, 185, 1600
gold, production 1601
Surplus Property Act, rulings against Alcoa under 114
Swaziland, barite, data 166, 168
chrysotile, production 149, 150
Sweden, arsenic, data 141, 142
cement, data 232, 235
chromite, data 245, 246
iron ore, data 602, 619, 622, 625
uranium minerals, data 1229
Switzerland, cement, data 232, 235
Sylvinite, production 1025
Sylvite, production 1025

T

Taconite, concentration, Bureau of Mines studies 613

Page

Taggers tin, foreign trade 1170, 1171
Talc, consumption 1153
foreign trade 1151, 1155
prices 1154
price control 1154
sales 1151, 1152
salient statistics 1151
world review 1156
Talc industry, annual review 1150
Talcum powder, exports 1156
Tantalite, stock pile 1273
world review 1274
Tantalum, annual review 1272
prices 1273
uses 1273
Tantalum concentrates, producers 1272
shipments 1272
foreign trade 1273
Tar, price control 407
products 404, 447, 448
uses 446
value 404
yield 405, 445, 446
Tar-acid oil, production 447
Tar pitch, production 448
Tariff Commission, Committee for Reciprocity Information, requests for tariff reduction on barite 163
Tatronite, discovery 1239
Tellurium, prices 1281
producers, list 1280
salient statistics 1280
uses 1280
Tennessee, bituminous-coal industry, data 272, 273, 285, 291, 295, 296, 297, 300, 305, 306, 310, 313, 314, 317, 318, 319, 320, 323, 324, 336.
copper, production 1417, 1421
gold, production 1415, 1416, 1421
lead, production 1417
minerals, production 28, 64
value 20, 64
nonferrous metals, production, annual review 1421
phosphate rock, review 988, 989, 990, 992, 993, 995
pyrites, production 1146
rhenium, production 1279
silver, production 1416, 1421
zinc, production 1417, 1421, 1422
Terneplate, foreign trade 1170, 1171
Texas, antimony, data 130
bituminous-coal industry, data 272, 285
brown iron ore, data 603, 604, 605, 606, 607, 614, 616, 618, 621
carbon black, production 200, 201
copper, production 1525, 1526, 1527
fluorspar, data 512, 514, 520
gold, production 1525, 1526, 1527
Hudspeth County, metals, production 1526, 1529
lead, production 1525, 1526, 1527
lignite industry, data 272, 273, 285, 290, 293, 294, 296, 297, 300, 305, 311, 313, 320, 336, 340, 341
magnesium compounds, data 740
mercury, data 770, 774
minerals, production 28, 65
value 20, 65
natural gas, review 809, 811, 812, 813, 814, 821
natural gasoline, data 838, 840, 842, 843, 844, 848
nonferrous metals, production, annual review 1525
ore, classification 1527
petroleum industry, review 878, 880, 882, 883, 884, 885, 899, 905, 907, 908, 909, 911, 912, 913, 914, 915, 917, 918, 919, 920, 922, 923, 931, 939, 941, 945, 948, 950, 951, 954, 958, 965, 968, 973, 975, 976, 977.
Presidio County, metals, production 1526, 1529
refining plants 1527
silver, production 1525, 1526, 1527
smelting plants 1527
sulfur, data 1138, 1159
zinc, production 1525, 1526, 1527
Texas Railroad Commission, natural-gas industry, investigation 808
Thallium, production, decrease due to labor strikes 1281
uses 1281
Thallium metal, prices 1281
Thorium, annual review 1205
foreign trade 1225

Page

Thorium—Continued
nonenergy uses 1223
prices 1224
production, controls 1203
reserves 1212
Thorium-cerium mines, location 1205
Thorium ore, production 1208
Tin, conservation orders 1162
consumption 1165
deposits, Bureau of Mines investigations 1162
foreign trade 1159, 1169
import control 1161
prices 1159, 1160, 1167, 1168
price control 1161, 1167, 1168
primary, production, mine 1159, 1163
smelter 1159, 1163
stocks 1166
production order 1162
purchases, foreign countries 1161
salient statistics 1159
secondary, annual review 1085
consumption 1086, 1166
detinning plants 1086
foreign trade 1088
preference orders 1088
prices 1086
recovery 1065, 1085, 1159, 1164
stocks 1086
value 1085
stocks 1159
world review 1172
Tin-alloy products, secondary, shipments 1082
Tin areas, Far Eastern, rehabilitation, delay 1159
Tin Committee, Combined, tin allocation 1172
International, meeting 1172
Tin Conference, International 1172
Tin Control Scheme, International, termination 1160
Tin industry, annual review 1159
Government control 1161
international controls 1172
Tin ores, RFC authority to purchase 1161
Tin plate, foreign trade 1170, 1171
Tin products, secondary, shipments 1082
Tin Research Institute, continuation proposed 1172
Tin Sales Corporation, operations 1167
Titanium, uses 1185
Titanium concentrates, foreign trade 1187
prices 1186
production 1184
shipments 1184
stocks 1186
world review 1189
Titanium dioxide, producers, production delay, due to labor strikes 1183
Titanium industry, annual review 1183
technologic data 1188
Titanium metal, uses, new 1183
Titanium pigments, production 1185
sales 1185
shipments 691
Titanium pigments industry, trial on monopolistic practices 1183
Toluol, production 447, 448
Topaz, shipments 1297
uses 1297
Trade agreements, Mexico, lead 668
Trap rock, crushed, sales 1122, 1124
sales 1103, 1105, 1107, 1109
Trap-rock quarries, employment, data 86, 87
Trap-rock-quarry workers, injuries, data 86, 87
Travertine, foreign trade 1134
Treasury, buying price, gold and silver 558
Tremolite, sources 143
Trinidad, asphalt, production 1563
limestone, production 1563
minerals, review 1563
petroleum industry, production 1563
Tripoli, foreign trade 109
prices 96
producers 97
production 93, 96
review 96
sales 96
Tri-State district, crude ore milled 1381, 1382
lead production 1369, 1370, 1373, 1377, 1378, 1379, 1380, 1382, 1383

Page

Tri-State district—Continued
metal recovered 1382
prices received per ton of concentrates 1381
zinc, production 1369, 1370, 1373, 1377, 1378, 1379, 1380, 1382, 1383
Tube-mill liners, producers 101
production 93
sales 100
Tungsten, world review 1202
Tungsten concentrates, foreign trade 1192, 1193, 1200
prices 1199
production 1192, 1193, 1194
salient statistics 1192
shipments 1192, 1193, 1194, 1195
stocks 1192
Tungsten industry, annual review 1192
Tungsten ores, consumption 1192, 1199
foreign trade 1192, 1193, 1200
production 1192, 1193, 1194
salient statistics 1192
shipments 1192, 1193, 1194, 1195
stocks 1192
Turks Island, salt, production 1562
Turkey, antimony, data 135, 136
Turquoise, production 547

U

Umber, foreign trade 1291, 1292
Union of South Africa, antimony, data 135, 136
asbestos, review 143, 147, 148, 149, 151
barite, data 166, 168
beryl, production 554
corundum, data 104
gold, review 581, 583, 586
iron ore, data 619, 622, 625
platinum metals, review 1008, 1009, 1013, 1015, 1016
tantalite, exports 1275
Union of Soviet Socialist Republics, aluminum, data 122, 127
asbestos, data 143, 146, 147, 148, 151
cement, data 232, 235
lapidary trust, production, increase 555
lead, data 684, 685, 689
sulfur, data 1145
uranium minerals, data 1230
zinc, data 1263, 1265
United Kingdom, aluminum, review 119, 122, 127
antimony, data 136
barite, data 166, 168
bismuth, data 189, 190
chromite, data 245, 246
copper, review 477, 488
ferrochromium, imports 246
ferrous scrap, supply 664
lead, data 684, 685, 689
magnesium, data 731, 735
manganese ore, data 765, 766
mercury, review 777, 781
tin industry, review 1159, 1160, 1161, 1168, 1170, 1171, 1173, 1174, 1181
titanium, data 1191
uranium minerals, data 1229
witherite, data 166, 168, 170
zinc, data 1263, 1265
United Nations, Atomic Energy Commission, establishment 1216
United States, mineral industries, annual review 1
mineral products 13, 15, 19, 21, 24, 28, 30
production 1, 15, 30
statistical summary 13
value 15, 19, 20, 30
United States Circuit Court of Appeals, cement companies, freight cost, permission to absorb 209
Uraninite ore, production 1208
Uranium, annual review 1205
consumption, for nonenergy purposes 1207
foreign trade 1224, 1225
Government control 1212
nonenergy uses 1222
prices 1207, 1223
production 1208
controls 1205
reserves 1211
technology 1226

Page

Uranium—Continued
use, atomic bomb 1206
industrial power 1218
military 1217
world review 1226
Uranium isotopes, description 1209
enriched, efforts to procure samples 1205
Uranium-radium mines, location 1205
Uruguay, minerals, production 1601
review 1601
Utah, agate, deposits 547
Beaver County, metals, production 1534, 1537, 1538, 1539
Bingham district, metals, production 1539, 1543
bituminous-coal industry, data 272, 273, 285, 290, 293, 294, 296, 297, 300, 305, 306, 314, 318, 320, 323, 324, 337.
Box Elder County, metals, production 1534, 1538, 1539, 1541
copper, production 1531, 1532, 1533, 1534, 1535, 1537, 1538, 1539
fluorspar, data 512, 514, 520
garnets, deposits 548
gold, production 1531, 1532, 1534, 1535, 1537, 1538, 1539
Iron County, metals, production 1534, 1537, 1538, 1539, 1541
Juab County, metals, production 1534, 1537, 1538, 1539, 1541
lead, production 1531, 1532, 1533, 1534, 1535, 1537, 1538, 1539
magnetite, data 603, 604, 605, 606, 607, 614, 616, 618, 621
manganese ore, shipments 754, 756, 757
metallurgic industry, review 1536
minerals, production 28, 66
value 20, 66
mining industry, review 1535
molybdenum, data 799
natural gas, review 809, 811, 812, 813, 814, 821
nonferrous metals, production, annual review 1538
obsidian, production 547
ore, classification 1535
Park City region, metals, production 1539, 1540, 1545
phosphate rock, data 989, 1000
Piute County, metals, production 1534, 1538, 1539, 1543
potassium salts, review 1025
Salt Lake County, metals, production 1534, 1537, 1538, 1539, 1545
San Juan County, metals, production 1534, 1537, 1538, 1539, 1545
silver, production 1531, 1532, 1534, 1535, 1537, 1538, 1539
Summit County, metals, production 1534, 1537, 1538, 1539, 1545
Tintic district, metals, production 1539, 1542
Tooele County, metals, production 1534, 1537, 1538, 1539, 1546
tungsten, review 1194, 1195, 1198
Utah County, metals, production 1534, 1537, 1538, 1540, 1547
vanadium, production 1234, 1235
variscite, deposits 547
Wasatch County, metals, production 1534, 1537, 1538, 1540, 1545.
Washington County, metals, production 1534, 1538, 1540, 1548
West Mountain district, metals, production 1539, 1543
zinc, production 1531, 1532, 1533, 1534, 1535, 1537, 1538, 1539

V

Vanadium, foreign trade 1232, 1236
Government regulations 1232
prices 1236
salient statistics 1232
uses 1235
world review 1237
Vanadium concentrates, production 1233, 1234
Vanadium industry, annual review 1232
Justice Department, prospective trial 1232
Vanadium ore, consumption 1232, 1235
production 1232, 1233, 1234

Page

Variscite, deposits 547
Venezuela, asbestos, data 151, 1603
cement, data 230, 231, 234
coal, production 1602, 1604
diamonds, production 1602, 1603
gold, production 1602
iron deposits, explorations 1602
magnesite, data 1602, 1603
minerals, production 1602
review 1602
nickel deposits, sampling 861, 1603
nonmetals, data 1602, 1603
petroleum, production 1602, 1604
salt, production 1602, 1603
vanadium, exports 1603
Vermiculite, annual review 1292
prices 1298
price control, removal 1297
producers 1297
production 1297
sales 1298
uses 1298
Vermont, asbestos, data 144
Barre district, granite, production 1109
sales 1109
copper, production 1417, 1423
gold, production 1416, 1423
minerals, production 28, 68
value 20, 68
silver, production 1416, 1423
slate, review 1099
Veterans' Emergency Housing Act, effect on building industry 588
provisions 626
Vicalloy, description 392
Virginia, apatite, data 996
bauxite, production 176, 177
bituminous-coal industry, data 272, 273, 285, 290, 294, 296, 297, 300, 305, 306, 311, 313, 314, 317, 318, 320, 323, 324, 337.
lead, production 1417, 1423
manganese ore, shipments 754, 756, 757
minerals, production 28, 68
value 20, 68
natural gas, review 809, 811, 812, 813, 814, 821
petroleum industry, review 903, 911, 912, 941, 950, 958, 968
pyrites, production 1146
slate, data 1099, 1100
titanium ores, deposits 1184
zinc, production 1417, 1423

W

WAA, lease, war natural-gas pipe lines 808
organization 9
sales, aluminum 112
ship-breaking program 645
stock pile, copper, distribution 461
secondary, attempts to market 1077
Waelz kilns, for smelting zinc, list 1248
War Assets Administration. *See* WAA.
War Production Board. *See* WPB.
Washington, antimony, data 130
Asotin County, metals, production 1552, 1556
bituminous-coal industry, data 272, 273, 285, 291, 293, 295, 296, 297, 300, 305, 306, 311, 313, 314, 318, 319, 320, 323, 324, 337.
Chelan County, metals, production 1552, 1554, 1555, 1556, 1557
copper, production 1549, 1550, 1551, 1552, 1553, 1554, 1555, 1556
Ferry County, metals, production 1552, 1554, 1555, 1556, 1557
fluorspar, data 512, 514, 520
gold production 1549, 1550, 1552, 1553, 1554, 1555, 1556
hausmanite ore, shipments 754, 756, 757
Kittitas County, metals, production 1552, 1556, 1557
lead, production 1549, 1550, 1551, 1552, 1553, 1554, 1555, 1556
magnesium compounds, data 740
metallurgic industry, review 1553
minerals, production 28, 70
value 20, 70
mining industry, review 1553

Page

Washington—Continued
nonferrous metals, production, annual review 1549
Okanogan County, metals, production 1552, 1554, 1555, 1556, 1557
ore, classification 1553
Pend Oreille County, metals, production 1552, 1554, 1555, 1556, 1558
placer mines, production 1552
1554, 1555, 1556, 1558
silver, production 1549, 1550, 1551, 1552, 1553, 1554, 1555, 1556
Snohomish County, metals, production 1552, 1558
Stevens County, metals, production 1552, 1554, 1555, 1556, 1558
zinc, production 1549, 1550, 1551, 1552. 1553, 1554, 1555, 1556
Water power, as source of energy 275, 276, 277, 278, 279
Wax, annual review 974
foreign trade 925, 975
prices 975
production 924, 925, 974, 975
salient statistics 925, 975
stocks 925, 975
yields 927
West Indies, coal, foreign trade 344
Westinghouse Electric Corp., study of commercial use of nuclear energy 1219
West Virginia, bituminous-coal industry, data 272, 273, 285, 291, 292, 295, 296, 297, 300, 305, 306, 311, 313, 314, 317, 318, 319, 320, 323, 324, 337.
magnesium compounds, data 740
minerals, production 28, 71
value 20, 71
natural gas, review 809, 811, 812, 813, 814, 822
petroleum industry, review 878, 880, 882, 883, 903, 905, 907, 909, 911, 912, 913, 914, 915, 917, 918, 919, 920, 922, 941, 950, 958, 968.
salt, data 1033, 1034
White lead, consumption 696
foreign trade 706
prices 691, 705
production 691
shipments 695
Whiting, foreign trade 1134
Wisconsin, iron ore, reserves 611
iron-ore industry, review 603, 604, 605, 606, 607, 608, 610, 614, 618, 621
lead, production 1370, 1384, 1385, 13
minerals, production 28, 72
value 20, 72
nonferrous metals, production, annual review 1384
pyrites, recovery 114¢
zinc, production 1370, 1384, 1385
Witherite, foreign trade 162, 170
price 170
Wollastonite, uses, possible 1298
Wood preservatives, arsenical, consumption 139
WPB, allocation, lithium 1277
conservation orders, uranium 1212
controls, gold-mining industry, cessation 557
Wurtzilite, sales 152
Wyoming, Albany County, metals, production 1560
bituminous-coal industry, data 272, 273, 285 291, 293, 295, 296, 297, 300, 305, 306, 312, 313, 314, 318, 319, 320, 329.
copper, production 1559, 1560
Fremont County, metals, production 1560
gold, production 1559, 1560
hematite, data 603, 604, 605, 606, 607, 608, 614, 616, 621
lead, production 1559, 1560
minerals, production 28, 73
value 20, 73
natural gas, review 809, 811, 812, 813, 814, 822
nephrite, production 546
nonferrous metals, production, annual review 1559
petroleum industry, review 878, 880, 822, 883, 884. 885, 903, 905, 907, 909, 911, 912, 913, 914, 915, 917, 918, 919, 920, 922, 923, 941, 949, 958, 968.
phosphate rock, data 997, 1000
silver, production 1559, 1560
titanium ores, deposits 1184

X

Page

Xylol, production 447, 448

Y

Yugoslavia, mercury, data 782

Z

Zinc, consumption 1241, 1254
foreign trade 1261
Premium Price Plan, bonuses paid 1242, 1257, 1258
prices 1241, 1260
price control 1257
primary, production, distilled 1241, 1250
electrolytic 1241, 1250
mine 1241, 1244
rolled 1255
slab 1241, 1251
smelter 1247
production, reduction due to labor strikes 1242
salient statistics 1241
secondary, annual review 1089
consumption 1091
foreign trade 1093
prices 1092
price control 1092
production, slab 1241, 1250
recovery 1065, 1090, 1252
shipments 1092
stocks 1092
stocks 1241, 1256
stock pile 1242
world review 1263
Zinc chloride, consumption 702
foreign trade 706
shipments 696
Zinc concentrates, prices 1260
Zinc dust, production 1252
Zinc industry, annual review 1240
Government regulations 1242
labor problems 1241
Zinc-lead mills, employment, data 90
Zinc-lead-mill workers, injuries, data 90
Zinc-lead mines, employment, data 83, 84
Zinc-lead miners, injuries, data 83, 84
Zinc mines, labor strikes 1241
leading, list 1246
Zinc ores, tariff 1243
Zinc oxide, consumption 699
foreign trade 706
leaded, consumption 700
prices 691, 705
production 691
shipments 696
prices 691, 705
production 691
shipments 696
Zinc pigments, distribution 692
foreign trade 691, 705, 706
manufacture, raw materials 703
outlook 693
prices 691, 705
salient statistics 691
shipments 695
Zinc pigments industry, annual review 690
Zinc products, secondary, production 1090, 1091
Zinc-reduction plants, list 1249
Zinc salts, distribution 692
foreign trade 706, 707
manufacture, raw materials used 703
prices 705
shipments 696
Zinc salts industry, annual review 690
Zinc smelters, labor strikes 1241
Zinc-smelting capacity, domestic 1248
Zinc sulfate, consumption 702
foreign trade 706
shipments 696
Zinc sulfide, foreign trade 706
Zirconium, annual review 1281
consumption 1282
prices 1283
producers, list 1282
production, domestic 1282
stocks 1282
uses 1282
Zirconium concentrates, refiners 1282
foreign trade 1283
world review 1283
Zirconium-ferrosilicon, uses 504